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INTRODUCTION: ANTHROPOLOGY IN SOUTH AUSTRALIA

C. ANDERSON & P. SUTTON

This volume marks what we hope is a regeneration of anthropology in the *Records of the South Australian Museum*. The *Records* began in 1919 and early volumes contained significant anthropological contributions, including major ethnographic works by scholars such as Tindale, Mountford, Birdsell, McConnel and Berndt. From the late 1950s, however, the anthropological content of the journal declined considerably, to a point whereby between 1968 and 1984 there were only two anthropology articles. Further, neither of these dealt with Australian Aboriginal culture. This is especially ironic given that the South Australian Museum has the largest and most comprehensive collection of Aboriginal material in the world.

From the present volume on, the *Records* will be publishing two numbers a year, and up to half of each will contain contributions which are anthropological in nature. Articles will deal with topics in all sub-disciplines of anthropology and all ethnographic areas. Obviously, however, our major concentration will be on areas best represented in the Museum collection (Aboriginal Australia and Melanesia). We are also interested in providing a venue for the publication of good ethnographic and other data. In recent decades, articles of this nature seem to have become unfashionable and as a consequence, scholars, particularly those with recent doctorates, are not encouraged to write articles which are primarily data-oriented. We believe there is a considerable amount of important material out there which should be written up and given wider scholarly access.

With respect to Aboriginal Australia at least, we want to encourage papers which have *land*, in all its forms, as a primary focus, whether this be through studies of land tenure, ethnoscientific investigations, or oral histories and texts relating mythological systems to landforms. There are two reasons for this. Such a focus fosters a multi-disciplinary approach which allows different views of similar problems. Secondly, there is a certain historical continuity in it which pleases us. As the paper by Philip Jones demonstrates, Adelaide-style anthropology from at least the 1920s was very much multi-disciplinary and data-oriented. There are certain of their assumptions (those relating to culture change, for instance), and methods (for example, exclusively short-term fieldtrips), which we may not share today. However, our own fieldwork (Anderson's and Sutton's) in Cape York Peninsula involving multi-disciplinary, land-based studies of Aboriginal systems, means that we have a fundamental affinity with the earlier work done out of Adelaide. It is interesting that the kinds of anthropology in Adelaide from the 1920s to the 1940s, and in Queensland in the 1970s, are more closely related to each other than they are to the work which was centred on Sydney and later Canberra over a similar period.

For this inaugural issue, we decided to focus on anthropology in South Australia, and exclusively on work done with or about Aboriginal people in the state. We have tried to include examples of research in most of the major sub-disciplines of anthropology (linguistics, prehistory and socio-cultural anthropology), excluding only physical anthropology (although this is discussed by Jones). Temporally too, we have attempted to be representative — going from 22 000 BP (Lampert & Hughes), through the immediately pre-European period (e.g. Tindale), to the recent past (Hamilton). As for geographic coverage, we have included papers dealing with most of the major regions of South Australia: the Adelaide area and the south-east, the Flinders Ranges and mid-north, the west coast, the remote north-west and the far north-east.

Norman Tindale and Ronald Berndt in their papers present mythological accounts from the south-east and Adelaide area up to the mid-north and over to Broken Hill respectively. Tindale gives a comprehensive account of the Kaurna myth of Tjirbruke, a culture hero whose travels and actions provided a central focus for Kaurna culture. (In 1986, markers were put at some of the sites in this myth in a joint government-Aboriginal project — termed the 'Tjilbruke Trail'.) Aboriginal site names, although mentioned throughout Tindale's paper, are not shown on his map as these are included in a larger work on the south-east which he is presently completing. Figure 1 is a general map showing the location of the main place names cited in the articles.

Berndt's paper concerns the so-called 'crocodile head' from Panaramittee on South Australia's eastern border. This object, now in the South Australian Museum collection, was thought to have demonstrated the existence of prehistoric crocodiles in southern Australia. Berndt convincingly argues that at least for the Ngadjuri around the turn of the century, the object was instead an important sorcery and healing object. Both this paper and that of Tindale, use mythological data to describe and elucidate aspects of the way of life of Aborigines

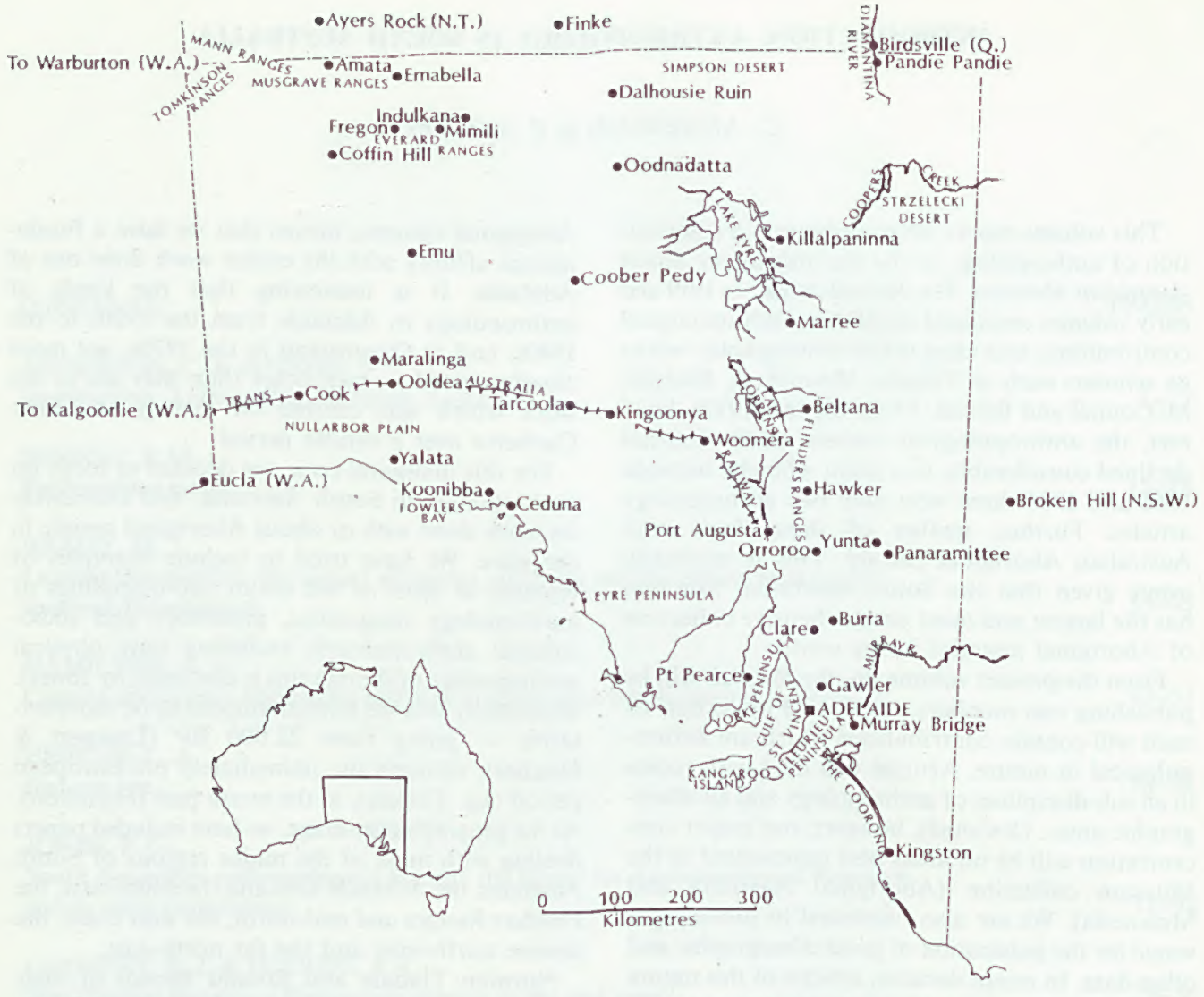

FIGURE 1. Map of South Australia showing place names mentioned in following articles.

in the southeastern portion of the state. It must certainly be rare to present new cultural material in such detail for southern Australia. Thus both articles are important ones.

One matter remains to be discussed with regard to Berndt's paper. Elkin (1950: 12) states that Berndt told him that the Panaramittee rock engravings were secret. Professor Berndt denies this, commenting thus:

> What I did say (as noted toward the end of page 8 of the article), is that I was told that these engravings were of the Dreaming and that traditionally they had mythological associations and songs concerning them. I think that was probably quite correct, but I have no evidence to suggest that any of them were 'secret' — and certainly not at the time I worked with Barney.
>
> On the other hand, in so far as the *yarida* ('crocodile head') stone is concerned, this could well have been a tabu-ed site . . . the *yarida* was dangerous for those persons who did not know its power or how to handle it. I believe we can assume that the actual engraving was not religiously 'secret' but magically dangerous to the uninitiated; and that it served to substantiate the use of *yarida* sorcery and as a 'prototype' indicating how this object should be made (Berndt pers. comm.)

The paper by Luise Hercus deals with one site, *MaRaru*, in the Simpson Desert in the far north of the state and the mythological associations which the site has with one toa. Toas are Aboriginal sculptures from the Lake Eyre Basin and are dealt with in the 1986–7 SAM exhibition 'Art and Land' and the related publication (Jones & Sutton 1986). Hercus concludes that this toa, as with the others, reflected the situation of Aborigines in the area in the early twentieth century, rather than some timeless 'traditional' period.

Ronald Lampert and Phillip Hughes present preliminary findings suggesting population movements between the Flinders Ranges and the Lake Eyre Basin, taking place at least as long ago as 22 000 BP. They argue that, in addition, these movements were major and recurring phenomena dependent on changes in aridity. These two papers illustrate some of the issues to be pursued in the major research programme which the South Australian Museum has under way in the Lake Eyre Basin (with the participation of two of these authors).

Maggie Brady's paper concerns moves by Pitjantjatjara people out of their original country in the north-west, south onto the west coast of South Australia, during the first half of this century. She discusses the various factors involved in these moves, including the attraction of rations, and the atomic testing in the west of the state. Some of the material in this paper was collected during the course of work which Brady was undertaking during the Royal Commission into British Nuclear Tests in Australia. We hope that in future we will be able to publish more of the valuable material that is produced during the many and varied consulting projects which anthropologists are so involved with these days. Too often significant work remains as inaccessible and uncited reports.

The Pitjantjatjara- and Yankunytjatjara-speaking peoples of the north-west are also the subject of Annette Hamilton's paper. Like Brady, she deals with population movements, but describes and analyses them on a far more micro-scale. Hamilton presents important data on camp composition and mobility from the period of her major fieldwork in the area (1970–1971). She questions the assumption that Aboriginal mobility patterns are the result merely of cultural continuities, demonstrating that even in an area of relative isolation where traditional values still dominate, mobility and population composition shifts can have just as much to do with the involvement of Aborigines in the wider, Australian economy (in this case, pastoralism).

In a fascinating piece of intellectual history, Philip Jones in his paper outlines the history of early ethnological research in South Australia, leading to the establishment of the Board for Anthropological Research in 1926. He describes the Board's expeditions up to 1939, its methods and assumptions, and, most importantly, the information resulting from each trip. Jones lists the films, still photograph collections, artefacts, genealogies, publications and many other records of Aboriginal life in Central Australia, South Australia, and elsewhere. He demonstrates that apart from perhaps the work of Spencer and Gillen, there is no better and more comprehensive overall documentation of Aboriginal life than that which emerged from the research of the Board and its members. Much of this material has never been used by anthropologists working later in the same areas. This paper is part of a larger work which Jones is undertaking on the history of the Board and its activities.

Like geological strata, the papers in this volume can be read as examples of different phases of Australian anthropological history. The age difference between the youngest and the oldest of the authors exceeds fifty years. The complementary good qualities of the various papers show that anthropologists of different backgrounds have much to gain from sharing their work.

Almost all the authors in this volume either worked at the South Australian Museum at some stage in their careers or have done research on some part of the Museum's collections. We are pleased that we have been able to bring papers by them together in this journal, as part of its anthropological 'rebirth', to present a picture of aspects of studies in the anthropology of Aboriginal South Australia.

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THE WANDERINGS OF TJIRBRUKI: A TALE OF THE KAURNA PEOPLE OF ADELAIDE

NORMAN B. TINDALE

TINDALE, NORMAN B. 1987. The wanderings of Tjirbruki: a tale of the Kaurna people of Adelaide. *Rec. S. Aust. Mus.* **20**: 5-13.

This is the story of the legendary activities and difficulties of an Australian Aboriginal ancestor of the Kaurna tribespeople of the Fleurieu Peninsula and the vicinity of Adelaide in South Australia, as brought together from the recollections of several aged informants. The problems faced by Tjirbruki, a renowned hunter of kangaroos, afford glimpses of early problems of conservation, and the consequences of transgressions of rules established to protect vital food resources. In the discussion some data are given on intertribal trade and the ways in which continuities of exchange were fostered from one generation to the next.

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The story of [Tji:rbruki][1], an ancestor of the Kaurna tribespeople of Aborigines on the eastern shore of St Vincent Gulf in South Australia (see Fig. 1), is a record of some events in the life of one of the heroic beings remembered in their traditions. In a 'remote' past Tjirbruki[2] was one of their ancestors. Although only a common man Tjirbruki was a wonderful person, a great hunter of kangaroos. He was neither as powerful as [ŋu'runduri] nor as awe-inspiring. Ngurunduri was the great being who had formed the Murray River and its end-lakes during his attempts to spear the gigantic Murray cod fish which he pursued, reach by reach, down the stream from the heart of the riverine areas west of the Great Dividing Range in eastern Australia. Nevertheless Tjirbruki was a great man. He was of the ['Patpaŋga] band or clan, the southernmost one of the Kaurna tribe, having their ['paŋkara] or territory along the shore of Rapid Bay and its ['wita] (peppermint gum tree) forested hills inland.

The setting of the story seems to show a people already established in their country. Already they were loosely divided into groups which seem to have had the same general distribution as the several present day tribes among which the story was told: the Kaurna, Ramindjeri, Peramangk, the Lake Alexandrina-dwelling Jarildekald, and the Tangane (of the Coorong shores which extend away to the south). Each of these tribes had links with Fleurieu Peninsula much as when the 'white people' first appeared early in the nineteenth century.

Our record of the activities of the man Tjirbruki is not complete but gives some insight into the ways of the earlier inhabitants as remembered by present day Aborigines. The account is based, not on direct text material, but has been brought together from conversations with men of four of the tribes over a long period between 1928 and 1964. At first the full import of the Tjirbruki story was not evident to this writer; thus the notes are widely scattered in his journals and in part therefore have been linked together from personal recollections. A firm basis for the story, as given here, is the one told to the late H. Kenneth Fry and me on the evening of 14 February 1934 during an extensive field trip on which we had been taken by Milerum of the Karagari clan of the Tanganekald tribe in a survey of his country along the Coorong. Having worked with me for several years, Milerum was a skilled informant. Our camp had been set near the coast opposite Tilley Swamp. It was a long story which he had heard at Yankalilla when he was quite young in the early 1880s. The narrators then were using Rapid Bay talk and Milerum attempted to use terms he had heard at that time. There were supplementary discussions thereafter on more than one occasion.

A summary of that part of the story which concerned the use of caves as burial places was published in an account of the archaeological excavation of Kongarati Cave on the coast of St Vincent Gulf (Tindale & Mountford 1936). A rather romantic version of part of the story, written in the florid style of some Grecian mythology, was published by William Ramsay Smith (1930) but is not used in this account.

The help of several informants is acknowledged. In addition to Milerum, Karlowan (Jarildekald tribe) supplied much data, and Reuben Walker spoke for the Ramindjeri and the people of Rapid Bay. Sustie Wilson, whose mother had been a Kaurna, also had some Ramindjeri details, while Robert Mason of the Mannum area recalled some details of the Peramangk he had learned from his mother who was of that tribe. In 1929 Ivaritji, a Kaurna woman, supplied the information about her father's and her own totem, the emu.

FIGURE 1. Map of Fleurieu Peninsula and Adelaide area.

THE WANDERINGS OF TJIRBRUKI

Tjirbruki and his fellow Patpangga clansfolk were living at ['Tankul'rawun] near Rapid Bay. Tankulrawun (its name has the meaning of the 'Granite place') was one of their summer camping places near 'Wita'watəŋ]. Today Witawatang is known as Rapid Head.

There came an urge among some of the members of the band assembled there, including some young visitors, to go north and arrange a hunt for ['kari] or emus. Many *kari* were to be seen in the ['ru:we], clan lands of the Tandanja people at Adelaide because that big bird was their ['ŋaitji], or totem. They did not kill them although they feasted on their eggs.

Tjirbruki, who was a hunter skilled in kangaroo spearing, did not wish to go, but his much loved ['na:ŋari] or sister's son, named ['Kulultuwi], who was visiting with him along with several companions, did so wish. Kulultuwi called his mother's brother ['wan:u] or ['kawanu] as did two other younger lads whom he persuaded to go along with him. Both ['Jurawi] and ['Tetjawi] bore the same relationship to Tjirbruki

although they were by different mothers. They departed hastily. (It may be assumed that their families accompanied them although the story, as told, often omits such details.)

Tjirbruki, not wishing to take part, shifted his camp more leisurely, moving through the *ruwe* of the ['Witjarluŋ] clan which began near ['Karika:liŋga], a name still on the map as Carrickalinga. He arrived at ['Wituwa'ta:ŋk] now known as Brighton. He and his family were welcome visitors in the clan lands of the ['Jatabiliŋ] at Wituwatangk, whose ['paŋkara] (hunting territory) extended northward along the coast beyond the place now known as Outer Harbour. Tjirbruki spent much of his time at Wituwatangk fishing for ['kurari], also called ['dar:awe] (beaked salmon, *Gonorhynchus greyi*). He used a special ['ŋe:re] or net, termed a ['dar:awenjeri 'ŋe:re], with which several persons helped in the haul.

Meanwhile Kulultuwi and his companions, travelling ahead, had sought out, and quietly were driving several emus ahead of them without revealing their presence, masking their moves by holding up shields of branches of eucalyptus leaves. They moved across the middle of the ['Mikawom:a], the Adelaide plain, because they needed to keep the birds close to the coast so as to corner them at ['Muldaŋ] on the northern tip of the Outer Harbour Peninsula. Ancestors had made the Port River for them so that this could be done. Four male *kari* and four females, known as ['tartja], were caught up in their drive. By keeping on the coastward side of the plain, the hunters were avoiding trespass on Tandanja hunting grounds because they had not received permission to take emus there. The hunt was going well.

However there was a disturbance. Near ['Patawiljaŋk], now called Glenelg, some Jatabiling women were cooking herbs in their hot stone ovens. This caused the emus to turn away inland. Kulultuwi had to race around, going far into the Tandanja *ruwe* by way of ['Medaindi], now known as Medindie, to prevent the birds escaping from the trap. During this trespass Kulultuwi had killed a female bird. Some *kari* had escaped but others were successfully held over several days at Muldang while the men and their families fed on the body of the *tartja*.

While this was going on Tjirbruki and other people with him had shifted camp to ['ʏulukudaŋk],[3] now called Kingston Park. From there he made short excursions inland. He saw the old tracks of emus and their hunters going north but also the fresh tracks of one male bird. He decided that this would be his bird to hunt, since according to custom the first to sight the presence of game had the right to take it. For a while he continued to fish, taking several further hauls of *kurari* for his journey.

Then Tjirbruki left, following the track of his *kari* along the coast to [Ka'reilʊŋ] (Hallett Cove) and on to ['Tainba'raŋ], now Port Noarlunga, to ['Ru:waruŋ] (Port Willunga), and to ['Witawali] where the tracks turned inland. There, near Sellicks Hill, the old name of which has been forgotten, the tracks were lost.

Meanwhile the hunters decided to go back to the rest of their people. They arrived at Wituwatangk during a very heavy morning fog, found the camp empty and that Tjirbruki had left.

Tjirbruki, having lost all traces of tracks, and judging that the male bird would continue its movements southward along the coast, turned inland on a path which took him through the valley at ['Maitpaŋ'ga] (which still bears the name as Myponga), travelling to ['Muta'pariŋga], a place where there are many blackwood trees, continuing down the Hindmarsh Valley ['Jaladula], and passing ['Jerlto'worti], to Victor Harbor at ['Lat:arŋ]. He still thought the emu might come around by the coast so he hid in ambush and watched for several days. No tracks appeared so he went back on his own trail and found a place where the old tracks had been covered by newer ones. There was good food for the bird here in the forest, far inland from his Witawatang camp at Rapid Head. In the distance he saw the smoke of a small fire and, heading in that direction, he heard the voice of Kulultuwi singing while one of the younger men was preparing a cooking fire for an emu Kulultuwi had killed.

This was the bird which Tjirbruki had been following and expecting to spear. He confronted Kulultuwi, claiming that his *nangari* had been wrong in killing his male bird. His own footprints should have indicated this to the younger man.

Kulultuwi said, 'Sorry, I did not know it was your *kari*. You saw the bird first. Cook it and take it home to your children'.

Tjirbruki replied, 'No! You killed it. You cook it and give us some of the meat'. He had some kangaroo meat and did not need the emu. Tjirbruki then departed.

Kulultuwi made ready the ['wintjimi] oven, making the bed of hot stones, placing the green herbs over them, putting the bird on and covering it with further herbs and earth, and pouring on water to make much steam. After waiting for it to cook Kulultuwi, as was customary, dug in and took out the head of the bird to see if it was ready when a sudden burst of steam blinded him. Thereupon his part brothers, Tetjawi and Jurawi, taking advantage, rushed in, speared, and killed him.

The boys reasoned they had killed their ['juŋalja], or elder brother, because he had transgressed, having really known from reading the tracks that the bird belonged to their *wannu*. The youths cut off the meat from the bones of the bird and carried it to their own people of the Jatabiling clan. They left the body of Kulultuwi. They told their folk that Kulultuwi had done wrong: ['ɲaitjau/'peindjəli] (in front of us/the emu). They used a northern word for emu, implying that the bird meat was evidence that Kulultuwi transgressed. Their people carried the body of Kulultuwi to ['War:pari] (Sturt Creek) on the Adelaide plains near Marion where they continued the drying of the flexed body on a rack over a fire.

The youths made up a story that Kulultuwi, in fear of the anger of Tjirbruki, had gone away elsewhere to hunt further for emus. When this false story reached him at Rapid Bay, Tjirbruki asked several members of the Witjarlung clan living north of his country give a message of forgiveness to Kulultuwi. Although they knew of the death of Kulultuwi they, with malice, did not tell him the truth.

Searching for Kulultuwi, Tjirbruki went first to ['Loŋkowar] (Rosetta Head), the great bluff on Encounter Bay, then up ['Mu:lapari] the Inman River

to ['Towara:nk], near Moon Hill, and on to ['Maikaba'naŋk] near the coast at Normanville. His family had gone with him. Then he began to wander about by himself, going as far as ['Nutaraŋg] (Lands End), at that time still in Kaurna country (according to informant Karlowan).

Heading north again, he came to the place near where he had seen Kulultuwi last and chanced to see some sugar ants on the track. He picked up some ants carrying human hair and others with blood and red ochre. Further on, he found more and knew in his thoughts that *nangari* was dead. He saw where the body had been, and where people had made a smoke fire. They had made a ['tirukati], or drying rack of poles tied together like a raft such as a man uses when fishing. On the third day they had, as was customary, covered the body with red ochre ['ta:u:we] from ['Potarta:ŋ]. They had carried the bier towards Adelaide.

Having made these discoveries Tjirbruki said, 'I have only one spear properly fixed. I am off!' He left the place in the *wita* (peppermint tree forest) and went towards ['Rāwarə 'ŋal] (Port Elliot). At Rawarangal he had opportunities, through his ['ŋiaŋi'ampe] trading partners, to obtain good spears which had come from the Tanganekald people on the Coorong. On the way, while walking along the ['Mu:lapari] (Inman River), he met ['Jorlu] the red-backed kingfisher (*Halcyon pyrrhopygius*) man. On hearing his story Jorlu gave him a spear, as did another man, ['Joldi] of the black cormorant (*Phalacrocorax carbo*) totem at the Finniss. Tjirbruki, with his new weapons, chose to follow tracks along the eastern side of the Mount Lofty Ranges through Peramangk tribal country, keeping to their eastern boundary to avoid serious trespass. On the way he camped at ['Wiljau'a:r] near Strathalbyn, then at ['Peiera] (Woodchester Waterfall), then at ['Motoŋeŋal] (Mount Barker), and at [Bə'rukuŋga], now the mining township of Brukunga. Travelling on through places not now remembered, he came to ['Kali:a] (Gawler) which was the begining of Tandanja clan country. Keeping near the coast he travelled south. He had learned where a big camp ['taldamari] was gathering at Marion on Sturt Creek. He arrived, very weary, at Witawatangk.

Children saw him and cried out, 'Here is old ['mutʌ̆ri]'. Old father's mother's brother soon was the centre of a gathering and he told them he would stay to rest only the one night. He saw that the two men, Jurawi and Tetjawi, were present. Acknowledging that Kulultuwi was dead, they deceived Tjirbruki about the real killers, blaming his death on strange people who might have been Peramangk tribes-folk who had come along the Mount Lofty Range.

Tjirbruki ignored their implications, knowing that they were lying. He practised deception also, saying, 'Yes! I know! Strange men came from the ['wir:a] (forest) country in the north'. He thus made out that he thought the young men were innocent. On the following day Jurawi and Tetjawi with their families made a part day's journey to Warrpari (the Sturt Creek at Marion) where they settled in at the big *taldamari* hut. The body of Kulutuwi was still being smoke-dried there on a rack. In the evening they began ['kuri] dancing for the old man and he initiated others. Then he sang the whole camp to sleep. He tested them by calling out, 'Come! Give help with a haul of *kurari* fish'. There was no response and the old man said, 'Ah! I've got you!'

Tjirbruki was a master at fire-making. He took powdered stringybark tree bark ['morθi] as tinder and set it around the *taldamari* with much grass, leaving only a small gap at the entrance. Then, using a [bə'ruke] (iron pyrites) stone and a piece of flintstone ['paldarī], he started fires at each pile of *morthi* or tinder, telling the fire to blaze up quickly. He cried out loudly: "Raŋkaŋ 'ŋaŋand 'haŋand 'dol. You are getting burned! Camp on fire'.

The top of the *taldamari* began to fall in as it burned and all the people attempted to rush out. As children came out he kicked them with his foot and hit them with his club. Out came Jurawi whom he speared with a ['wundi] or dread-spear, one set with quartz chips in resin on its head. The spear entered Jurawi right up to the ['tʌ̆ŋgi] or swelling of resin set on the spear to prevent its too ready removal from the wound.

Out came Tetjawi whom he speared also and held in the fire. Only when he felt no further kicking did he accept that 'they were done'. He pulled out the spears and waited until morning as the *taldamari* burned to the ground.

Tjirbruki took the dried body of his *nangari* to [Tulukudaŋk], a spring of good water on the beach of Kingston Park Reserve at Marino. There he completed the smoking of the body of Kulultuwi and an inquest was held. Many people gathered for the ceremony. The names of the two killers were confirmed. Tjirbruki learned that his *nangari* had indeed been struck down while raking the head of the emu from the fire, looking for the steam coming from its bill, indicating the bird was cooked.

Carrying his burden, now a dry compact parcel, Tjirbruki said, 'I go back now!' He departed, walking along the coast to [Ka'reilʌ̆duŋ], now called Hallett Cove, where he rested. As he reclined he began to think about his nephew and burst into crying [ka'reilʌ̆dun]. Tears ran down his face and where they fell to the ground a spring of water welled up (thus the spot became a camping place). Tjirbruki then journeyed to ['Tainba'ra:ŋ] (Port Noarlunga) where he burst into fresh tears. He went on to ['Potarta:ŋ] (Red Ochre Cove), Section 362, Hundred of Willunga, where he cried again; yet another spring of water came up. He then walked to ['Ruwaruŋ] (several hundred metres south of Port Willunga jetty). The tide was out. He sat down on the beach and cried once more. The ['lu:ki] (tears) dropped on the sand, causing a spring to appear. At high tide the sea covered it, but when the tide fell again the fresh water could be obtained by scraping in the sand. It remains so today.

The old man then carried the body to ['Witawali] on the beach north of Sellicks Hill. He noticed that there was a fine bay which would serve at night as a good netting place for sea salmon. His tears were still flowing and brought a spring into being there (vicinity of Section 639, Hundred of Willunga).

While there, Tjirbruki began to think of further grudges and as he was passing through the *pangkara* of the Witjarlung families it disturbed him that they had failed to pass on his message of forgiveness to Kulultuwi and his other nephews. Instead of continuing

along the beach he turned inland and climbed over Sellicks Hill. He kept Maitpanga on his left and climbed another high hill (it may have been Mount Jeffcott or Black Hill). There he made a smoke signal. White smoke went straight up. People who were camped at a place called ['Warabari] saw the smoke and began to interpret its meaning:

'Turtil garwand 'werati. (Smoke plenty/going upwards.)
Korn 'loro 'kutu 'malbur 'undul'. (Men/straight up/good news of killing.) (In this loosely translated remark ['malpuri] given as 'guilty of murder' in Jaralde.)
'Itji 'nel lund'. (He is coming home.) (In Tangane ['ŋerei'luna] has been translated as 'quickly; wasting no time'.)

Tjirbruki made other fires as he picked up the answering smoke, and continued to do so until he was close enough to hear the people shouting. It was the camp of the men ['Limi] and ['Ŋarak':ani].

'Naitj purntulunul.' (He is coming.)

Those who were still in their huts asking:

'Jaŋaleitj?' (How far away?)
'Nitj teipuland.' (He is close.)

Tjirbruki heard their questioning. He untied his bundle of spears, taking as many as he could hold, and walked directly into the camp. A first spear he drove into Ngarakkani, another into ['Ŋeŋara'tawi], a third into Limi, and the last one into ['Tul:aki]. (Even in those days it was proper to spear people in the legs unless murder was the direct intention). The men saw that Tjirbruki meant mischief and all took headers into the water and turned into fish. Thus, in the sea off ['Ŋaldeŋga] today you will find ['ŋarak:ani] (the gummy shark, *Mustelus antarcticus*), ['limi] (the cobbler carpet shark, *Sutorectus tentaculatus*), also ['ŋeŋara'tawi] (the southern fiddler, *Trygonorrhina guanerius*), and ['tul:aki], 'the long thin shark with the flag on it' (which we have not identified, although it perhaps is the cocktail shark, *Carcharhinus brachyurus*). These fish became the *ngaitji* or totems of members of the Witjarlung clan of the Kaurna tribe. Any other people who were present when Tjirbruki took his revenge fled and turned into birds, leaving only the old man there, alone. Satisfied, Tjirbruki stayed there a while, and when his nephew's body was again dry enough to carry, he rolled it in a kangaroo skin and continued on his journey.

Tjirbruki came to ['Karika:liŋ'ga] (Section 1018, Hundred of Yankalilla), just south of the place known to Europeans as Carrickalinga Head. Here there was (and is, for informant Karlowan had seen it himself) a little swamp flat where ['ŋuri] grows, very green like a reed. Rafts, called ['kundi] (not ['kandi] as misprinted in an earlier publication) were made of the dried stems of this plant (probably a *Typha*). Tied up in bundles, they were so used along the Murray River.

Continuing his journey along the coast Tjirbruki went to ['Koŋarati'ŋga] where there is a ['perki] or cave. Just before he arrived at the *perki* he again sat down and cried: a small spring flowed there. He did not go into the cave but walked further on, a few hundred metres to the mouth of a small creek that is a camping place. He continued walking, sometimes on the shore and at other times above the cliffs, all the way to ['Parewar'aŋk] (now Cape Jervis). From Parewarangk he returned northwards along the foreshore below the cliffs and came to another *perki* (called [Ja'narwiŋ] by another informant). It is close to the place from which you *janarwing* (turn back) because the water is too deep for one to pass along the shore.

Tjirbruki left his nephew's body outside and, walking into the darkness, found a place where there was a suitable ledge of rock. He put sticks up, just as was done when the body was being smoked, carried the body in, placed it on the platform, and left it. He did not emerge from the cave but went on into the depths of the hill for a long way. He made the way wide enough for him to continue inside right up on top of the range at ['Waṯeira 'ŋeŋgal] (now Mount Hayfield). Emerging there he shut the 'airhole' where he came out. He 'fixed it up with gravel' to appear he had 'never come out there'. Going down to the foot of the hill he shook his body and dust came off him. This became the ['mulkali] (yellow paint or ochre) which is used for decorating or 'making spears flash'. (A further comment from the informant: 'Gold has been found there; it may be from off him').

Tjirbruki arrived at ['Tjutju'gawi] (west of Mount Robinson), the camp of the Ramindjeri tribesman ['Ken'gori] of the ['wanma'rai] totem (ring-tail possum, *Pseudocheirus peregrinus*). Kengori was a member of the Polumpindjeri clan and Tjirbruki received permission from him to take *wanmarai* so that he could make a skin rug for the coming winter. He was feeling old. He looked out and saw a swampy lagoon and said to himself, 'There is no use in my living like a man anymore'. However, he left the camp of Kengori (whose adventures, which became a separate story, took place after Tjirbruki departed). The old man walked along the southern shore of the Fleurieu Peninsula on land well above the sea until he came to the ['koiŋkanja] or 'high hill' called ['Loŋkowar] (Rosetta Head).

'This place will do for me', Tjirbruki thought. 'How will I do it?' The answer came. On a tree nearby there was a bird, a ['kelendi] (the grey currawong, *Strepera versicolor*). He stalked the bird, killed it, plucked the feathers, and then rubbed the bird's fat over his own body. He recalled that ['Kelendi], when he was still a man, was a great messenger who travelled around the country singing songs and telling people of the coming meetings for initiation of their young men. Tjirbruki tied the bird's tail feathers on his arms with hairstring. Then he split the flesh between his big toes, and the third and fourth ones, made a run, and 'straight away started to fly'. As a ['tji:rbruki], which white people today called the glossy ibis (*Plegadis falcinellus*), his spirit still appears in bird form where there are swampy areas. His body became a ['martowalən] (a memorial), a rocky outcrop at Barukungga (on Section 1887, Hundred of Kanmantoo), the place of 'hidden fire'.

Discussion

It can be inferred that at the time of the actions in the story the people of Fleurieu Peninsula and the Murray Lakes region had already settled into patterns of life similar to those of recent date. They moved to the shores in summer, and inland seeking shelter and firewood in winter. Autumn was the season for hunting furred animals to use for rugs and cloaks against the coming cold and wet season. It was then that elders who claimed such furred animals as their *ngaitji* or totems permitted hunting for them by others.

The custom of giving of the navel-string emblem at birth, the so-called ['ŋiaŋi'ampe], passing it to a family in some clan distant from a clan of one's own tribe, or even, in more than a few instances, to one as far away as beyond bounds of the adjoining tribe, was already in operation. It involved, when the child moved to maturity, linking with a continuing silent trading system which helped to give him protection in the receipt of materials essential to his welfare, but not obtainable in his own living area. Special rules which prevented his meeting his trading partner, or even speaking to him, afforded protection.

Details in the story imply that the actions took place before the disruptions which eventuated when the Kaurna folk accepted the new male initiatory rite of circumcision, presumptively many centuries old. This rite came to them from the north. The incidental references to initiation seem to hint only at ways practised until the present time by the people of Lake Alexandrina, the Coorong, and at Encounter Bay. However, as none of the Kaurna tribesmen furnished details for the tale, we may not have a clear picture.

A reference to Peiera in the country near the present day town of Woodchester may become a little more significant if a brief outline is given of initiation and trade happenings there which, in the Woodchester area, seem to have continued up to the historical present. It appears that even in the time of the Tjirbruki story, important messengers circulated among the kindred tribes of the Peninsula carrying news of impending events, whereupon in due course many clans or families would begin to drift, particularly along tribal boundary lines, to the announced gathering place, quite often to well-wooded country in the general area of Peiera, a place at the point of confluence of several tribes even in more recent times. Such calls for initiation gatherings were made at intervals of several years. As the weather began to ameliorate in spring there were closer associations and gatherings with dances, enactments of incidents of stories, and the singing of songs. Also there were confrontations for the settling of disputes and even combat and killings. The passing of articles of trade took place at such times, always indirectly, since persons linked by their *ngiangiampe* bond did not speak to each other.

These occasions were the times of arrangement of future marriages, brides being sought for youths about to be initiated. Such youths had been for some time in casual isolation losing some childhood associations with their family and learning to forage for foods on their own in association with other boys of like age. This became increasingly so as the youth began to show signs of manhood and was ritually driven from the women's camping area. After being subject to such ceremonial events as depilation and being placed in a state called [na'rambi] or sacredness, he was coated in red ochre, subjected to special rules of behaviour, including avoidance of any contact with the opposite sex, and ritual avoidance of water, carried to extreme in that he might only imbibe it through a hollow reed and be carried over any streams that stood in his way. The cicatrisation of his body was an important event, as also, in some tribes, the ritual removal of an incisor tooth.

It was at initiation time that some older men might lead parties of younger men and youths on tours of country which they would not see at any other time. One known excursion from Peiera took such a party across the Mount Lofty Ranges west to Potartang, or Ochre Cove. With the assent of navel-string-partners they would be allowed to carry away parcels of the red ochre which was important for their decorative needs. For the implementation of such a trade, Tangane youths, for example, would have carried from their own home areas bundles of spearshafts of the special mallee woods which could best be obtained in the country inland from the Coorong. Flint pieces in packages also could be carried. Such flint would originate from as far away as Kingston in the south-east, having been traded from the Meintangki, but such trade-pieces were rare enough that the Tangane seldom received sufficient to have any surplus to pass on. Special needs of the Coorong people included good quality red ochre, stony pieces of iron pyrites and parcels of shredded stringybark tree bark, *morthi*, a powder valued as tinder needed for the lighting of fires using the percussion method.

On these excursions they could receive permission to hunt for some kinds of meat which were reserved normally for their elders. In the Tjirbruki story it is seen that emu meat was forbidden for young men. The settings of the hunting activities described are linked with the Tandanja clanspeople of Adelaide and vicinity on the eastern side of the Adelaide Plain. The Tandanja folk had the emu as their *ngaitji*. In fact, both Ivaritji, a member of the Kaurna, and her father, Parnadeitja, claimed this bird as their totem. Thus Tandanja elders of the emu totem, who did not kill emus, were reluctant that

others should do so because the birds in season provided them with eggs as food. Similarly, men of the Ngarkat tribe in the mallee desert east of the Murray River avoided the killing of ['lawan], their mallee fowl (*Leipoa ocellata*), the mound-building bird. It seems evident that these Aborigines had pragmatic ideas for conservation of resources.

Tjirbruki, whose ancestors came down the Murray River with the great being, Ngurunduri, was born at ['Watira'ŋeŋgul], also known to more eastern people, the Tangane, as ['Wataraŋalaŋ]. It was an important living area in the vicinity of Mount Hayfield, close to a spring on Section 115, Hundred of Yankalilla. From ancient times it has been one of the southernmost living places of the Kaurna tribespeople; their local clan was called the Patpangga and their summer living area was around Rapid Bay. Other clans with their separate ['ru:we] (lands) and ['paŋkara] (hunting areas) extended north along the shores of the St Vincent Gulf to Port Wakefield and even further north, inland to the vicinity of Crystal Brook where their northernmost clan, the ['Padnaindi], had its living space. The names of the several clans between Gawler and Rapid Bay are mentioned as being involved in the story of the wanderings of Tjirbruki. For further detail of the several tribes mentioned in the story see this author's book on Australian tribes (Tindale 1974).

Tjirbruki is remembered as the 'creator' (perhaps better translated as 'finder' or 'explorer') of springs of water, a vital necessity for all people. He also had a link with the making of fire, equally important in the cold and wet winters on the southern shores, directly exposed as they are to the chilly southwesterly gales coming from the icefields of Antarctica.

The totemic mantle which Tjirbruki assumed also linked him with fire when his spirit became that of the glossy ibis (*Plegadis falcinellus*). His body was turned into stone as a memorial when it became the hill of iron pyrites near Nairne on the eastern slopes of the Mount Lofty Ranges and the place which supplied the hidden fire held in its rock. We learn that his very name has the literal meaning of fire, ['tjiraŋgabruke] or 'hidden fire' which, according to informant Karlowan, was one of the terms used by the Jaralde for trade pieces of that stone. The Tangane term linked with the stone, as given by Milerum, is [bə'ruke] meaning 'fire'. His mother, who was of the Potaruwutj tribe, called it [pa'ruki] but at times said ['wan:ap], a word used further north by the Ngarkat tribespeople.

The Tjirbruki mining area, called by the Aborigines [Bə'ruk:uŋga] was on Section 1887, Hundred of Kanmantoo, and is now part of the township of Brukunga. It was on a hill about fifty metres above the north/south flowing Dawsley Creek. According to my son, Anthony J. Tindale, an engineer, the vicinity has been much altered in appearance by the extensive commercial mining of the iron pyrites for the production of sulphur, beginning about the year 1954. However, the whole mining area at present is in disuse.

The percussive method of fire-making was old in the area covered by this story and was in use when the first Europeans arrived in the early nineteenth century. According to Milerum and his demonstrations it is clear that the rather battered pieces of flint ['menpi] still to be picked up on their old camping sites are unquestionably the so-called 'fabricators', named thus by some archaeologists who have not, in the past, been in communication with the living. This has, incidently, been a dire failing with archaeologists the world over who are so myopic that they still call a wide array of stone implements 'scrapers', even though their functions as chisels, adzes, and knives are 'writ large' in the wear and abuses that have led to their abandonment. As a newcomer to the archaeology of the American Indian in 1959, I was shocked to learn how often the stain-marks on age-old stone implements were cleaned off before study, thus removing the evidence for the resin haftings which have for as many as ten millennia helped in the hafting of the tools so casually termed 'scrapers'.

The idea of the transmutation of ancestral beings at the end of their earthly wanderings into prominent features of the landscape, or in the case of others into astral beings still wandering about the heavens and guiding earthly activities, is a very widely held one in Aboriginal Australia. The concept is well-documented and noted in such Western Desert tribes as the Pitjandjara, Ngadadjara, Nakako, and many others.

An ancestral being, after travelling about his domain, contending, discovering, and 'magically' preparing the land for his totemic descendants, could pass into or attain a state for which the Pitjandjara, for example, use the term ['tjuruŋa'raka]. The spirit enters into a new form. Often it enters directly into the earth at some particular place, usually one of special import to the members of the tribe. To account for stories common to more than one tribe the beings, at times, could emerge again in the territory of another people and have further adventures before again becoming *tjurungaraka* elsewhere.

Often a being of a specific totem becomes a prominent topographical feature. Thus a being with the brown hawk name may become a place useful as a lookout upon which present-day brown hawks, its descendants, may perch and watch over present-day men of that totem.

Places noted for particular products are often so

denoted. Thus, in a story of two ancestral dog beings who appeared among the Ngadjuri people north of the Kaurna (Tindale 1937), the blood of a reddish-colored one became a reef of red ochre, and the black one's blood also was spilled to become a deposit of black wad, or manganese. Both are minerals important as pigments for the bodies of men while dancing, and for the decoration of young men being prepared for their initiation into manhood.

Among the Tangane of the Coorong such beings could become ['ma:towalə], taking the form of some unusual feature in that country, or could even be marked by such a feature as a clump of trees from which a being had made his spears or other weapons. The same term applied to memorials represented in the heavens as wandering planets, or stars as beings seated around their campfires. Meyer (1843) recorded a similar word used by the Ramindjeri of Encounter Bay, *marto-wallin*, translating it as 'becoming stone or being transformed into stone'.

In the same work Meyer noted that a similar term, *matenggauwe*, signified a 'song used by the Adelaide Aborigines'. It is possible that this was a term applied by them to songs about ancestral beings.

One song linked with Tjirbruki has come down to us. It was recalled by Milerum and sung for me in November 1937 when it was electrically recorded on Disc No. 1 *Clarence Long Series* of phonograph records, now in the South Australian Museum collection.

Called the 'Song of Njengari' it was published (Tindale 1941) but should be recalled here since its subject may give a useful lead as to the possible time when the pattern of the present day Tjirbruki tale was first laid down. Also it may well be the only *matenggauwe* song of the Kaurna that has survived.

Njengari was a kinsman of Tjirbruki. He was of a happy disposition and given to dancing. With his companions he made a dancing place on the coast at ['Watbardok] on the shore of the Peninsula between Sections 60 and 207, Hundred of Yankalilla, close to the cave in which Tjirbruki left his nephew's body. That cave is said to open on the cliff a little to the north of it and near the place where people have to detour, *janaawing*, because of the cliffs entering the sea.

'Min'arta:ŋgalau 'ŋareilkundaŋal
glad (start dancing) dance
'kundaraŋalilau 'jiŋgaraŋal 'ŋeitambara
make a level place dust rises set the nets
'ŋalau 'Watbardok ŋandei wat (h)elda:nji
around Watbardok tide rising go up
'wa:waŋk 'jan 'a:wiŋ
go up go back

Rejoice, clear the place for dancing; make a level place — see the dust fly!

We set the nets around at Watbardok; tide rises — we climb the cliff again.

The coastal land which Njengari used for dancing is now under the sea and today the place is a renowned beach for netting. The smooth sand enabled the nets to be successfully drawn during the first hour of the rising tide. To engage in fishing one climbed down the cliffs. The fish were taken and as the tide rose men climbed the cliffs again or risked being cut off by the rising waters.

Unlike Tjirbruki, whose body became a rocky memorial at Brukunga, the Kaurna saw the transformation of Njengari as taking him into the heavens where he happily remains as the star Njengari, of whose identity we have no clues.

The archaeological details of the places mentioned in this paper have not been as yet fully developed. An account by Robert Edwards (1964) is of particular interest as indicating long occupation of the camping place at Marion on the Sturt River which he calls 'Warriparri'. A part of the area is still preserved as a park, but a shopping centre now dominates the scene. Indications are of the permanent presence of water supplies and large red-gum trees margining the winding stream bed. There are signs of very recent occupation, and on the eroded area there are some stone implements of the Kartan phase of occupation, indicating the presence of people well before the last cold phase of the Wisconsinan or Last Ice Age. It is more than unlikely that the period recalled by the Tjirbruki story goes very far back but it does suggest that the Adelaide plains had already been subject to man's attention long before the days of Tjirbruki.

Studies of some other places mentioned in our story are being developed under the auspices of the Anthropological Society of South Australia. Recent work has been summarized in a work under the editorship of Betty Ross (1984). It indicates some of the fascinating details which can be gleaned on the ecology and prehistory of the First Australians in their adjustment to the often harsh, but sometimes rich, environment in which they lived.

Endnotes

1. In this paper when individual Aboriginal words and names are mentioned for the first time they are transcribed in International Phonetics as set out in my book on Australian tribes (Tindale 1974: 2) and placed within square brackets. When used thereafter they are given in close conventional form, with place names in particular following the mandates of Geographic II spelling.

2. The spelling [tji:rbuki] was used in my first published account of this legend (Tindale & Mountford 1936). It is now clear that ['Tji:rbruki] is more acceptable in view of the semantics involved. Thus Tjirbruki is the best available conventional spelling.

FIGURE 2. An Aboriginal encampment, probably near the Adelaide foothills, 1854. Alexander Schramm, courtesy Art Gallery of South Australia, Adelaide (Accession No. 761HP1).

3. The v mark set over some T, t and d consonants indicates that that part of the word should be spoken with the tip of the tongue between the teeth. It may be of interest to readers that the interdental series of sounds were first drawn to the attention of two anthropologists who were attempting to attain a satisfactory pronunciation, when the Jarildekald Aboriginal Karlowan, who was one of the main informants for the story of Tjirbruki, at a critical moment exclaimed 'Stick your tongue out, man!'

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PANARAMITTEE MAGIC

R. M. BERNDT

BERNDT, R. M. 1987. Panaramittee magic. *Rec. S. Aust. Mus.* **20**: 15–28.

This contribution concerns the well-known rock-engraving identified by C. P. Mountford as the Panaramittee 'crocodile head', and often cited as evidence of the existence of that creature in southern Australia during prehistoric times. On the basis of Aboriginal information obtained in the early 1940s, its interpretation as a *yarida* magical object provides a different view of what Aborigines believed it to be. Discussion places this engraved design and what it signifies within its socio-cultural context, along with mythological accounts that substantiate the relevance of this object. The major focus is on a description of two Aboriginal drawings of the 'crocodile head' as a *yarida*, and the meaning of its various designs. In order to understand how the object was used, the theory and technique of relevant sorcery, particularly in so far as dead person's fat is concerned, are outlined. While this paper does not refute any speculation on what the original intention of the engraving may have been, it makes clear that for the Ngadjuri, in whose territory the engraving was previously located, it was a representation of a magical object that has a history of human use and significance.

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I began working with Barney Waria in 1939, and continued from time to time after that until 1944. Mostly we talked together in Light Square, occasionally at my father's home in Rose Park, and in 1942 at Murray Bridge when he was staying with his old Yaraldi friend, Albert Karloan. My wife and I had been banned from entering Point Pearce Aboriginal settlement when Barney was living there. (We had criticized the actions of a United Aborigines' Mission (UAM) missionary, including his showing of secret-sacred objects to school children at Ooldea. After that we were officially barred from a number of Aboriginal reserves, including Point McLeay, although these were not under UAM control.) However, he and his relatives came outside the 'gates' to talk with us. But Light Square was our usual meeting place, as it was for many 'West End' Aborigines and Aboriginal visitors to Adelaide.

One day in April 1944, after spending some time sitting talking in the Square, Barney and I walked together down North Terrace to visit the South Australian Museum. On our way through the Aboriginal gallery, we paused to look at the engraved Panaramittee 'crocodile' stone (see Fig. 1 which is of the original engraving that was then on display). Barney told me that this was 'the magic spirit stick'. Opening his arms wide as if to embrace the gallery of objects, he added, 'It's wonderful that we can look at all these things and know their meanings, wonderful to think of the power and the songs and the ritual associated with them, to think about all that has gone. But what they were, lives only in the minds of few of us!'.

I had discussed this 'magic stick' with Barney earlier on, at Murray Bridge. He had raised the matter himself. He told me this engraving was not a 'crocodile' head at all. Having been intrigued by C. P. Mountford's trip to Yunta and by his discovery, not least because of the publicity it received in the local press of 1938, as elsewhere (see Mountford 1929: 243–248 and Mountford & Edwards 1962: 97–99), I was interested in what Barney had to say. He first drew for me a rough sketch of this object in chalk on brown paper. As a result, I wrote to Mr H. M. Hale, the Director of the Museum (since I was at that time an Honorary Ethnologist); and he kindly sent me, not only the photograph already noted (Fig. 1), but also some sketches of the so-called 'crocodile head'. Figures 2 and 3 reproduce two of these, the first 'the present rock surface' and the second 'the newer engravings'. My intention was not to detract from Mountford's speculation about what the engraving might mean. My interest was in obtaining an Aboriginal explanation. I should perhaps note that I mentioned this to Mountford, who was upset about my intention to do this. In the circumstances, and because he was then a friend of mine, I agreed not to publish at that time any information I might obtain on the object. After all those years, however, it seems important that the material should now be made available, and I feel that I owe it to Barney's memory to put it on record. I doubt whether any other living person, Aboriginal or non-Aboriginal, would know about what I propose to write here, and certainly not from his point of view.

FIGURE 1. Rock-engraving of the Panaramittee 'crocodile head'. (Photo courtesy South Australian Museum, 1942.)

FIGURE 2. Sketch of the Panaramittee design, part of which has disappeared. (Courtesy South Australian Museum, 1942.)

Barney Waria and Ngadjuri Country

Barney Waria (*waria* is a term meaning 'second child' of his parents; sometimes now spelt 'Warrior'), after he was circumcised (became a *vadnaba*), was named Ngadjibuna (or Ngadjelibuna), which means 'give nothing away' (referring to the secrecy of the Law). He was born at Orroroo in Ngadjuri country in 1873, and in 1943 was 70 years of age — a birthday that we celebrated with a Chinese lunch in Hindley Street. Barney (Fig. 4) was a *gararu* matri-moiety man whose 'meat' (or 'totemic' affiliation) was curlew, *wudlaru* and *wada* rat. The first served to aid him in times of need, as well as acting as a spirit-familiar. His father, Ned Edwards, was part-Aboriginal, part-Afghan, born at the Boli Aboriginal camp near Gladstone: he was killed in a dray accident at the age of 60 years, when Barney was six or seven years old. Barney's mother was Emily Lamb, also part-Aboriginal, born at 'Yonggala' station out from Jamestown and Terowie. She died 'naturally', aged

FIGURE 3. Sketch of the Panaramittee design, depicting what were regarded as being later engravings. (Courtesy South Australian Museum, 1942.)

60 years, when Barney was about 30 years old. Barney travelled widely in the middle-north of South Australia, went north as far as Oodnadatta, and up the Birdsville track into Queensland several times. He had been living at Point Pearce for 10 to 12 years prior to 1943: he died in 1948. Tindale (1937: 149) reported having worked with Barney who was on a brief visit to Adelaide: at that time, Tindale said, Barney was 'a middle-aged man'. In 1937 Barney would have been 64 years old, although of course Tindale could have spoken with him earlier. Barney was a perceptive and thoughtful man with a large repertoire of traditional knowledge that I could only sample. One difficulty was that while I was engrossed with the Yaraldi, my wife and I were also working with a wide range of Adelaide Aboriginal people of differing socio-cultural antecedents who were either resident in or visiting Adelaide. Barney's interest in his own traditional background did not deflect him from a lively concern about world affairs (at that time dominated by World War II), and he also played an active part in supporting claims for recognition of Aboriginal rights.

Originally, according to Barney, the Ngadjuri (*ngadlu*, we; *yuri*, person) occupied more or less the same span of country as noted by Tindale (1940: 180). It stretched south to Angaston and Gawler; and along with the Adelaide people, they were probably the first groups to suffer the full impact of alien intrusion. Their territory to the north included Panaramittee and Yunta. The Balaklava area was not part of the Ngadjuri country but was settled by the Widninga. Tindale said this was a Ngadjuri term for the Kauna (or Kona, as I call them), the Adelaide people. However, my information suggests that the Widninga did not identify themselves as Kona. The Wetara family, along with some others, were Widninga; their country adjoined that of the Ngadjuri as it did that of the Nukana, ranging along the gulf coast with its main base at Port Germein. There were rich fishing grounds within that area, and the Ngadjuri would join the Nukuna, seasonally, to exploit their resources. On the north too, the Ngadjuri interacted closely with people belonging to territories called by Tindale (1940) Jadliaura and Wailpi. As far as the Ngadjuri were concerned, the territories and people of those two groups were Adnyamatana (Adnyamathanha or Anyamatha) or, alternatively, Gunyumata (*adnya* or *gunya* or *ganya* meant stone; *mata*, people [belonging to]), referring to people who lived in the hilly and stony country. Barney said that, with the reduction of Ngadjuri numbers after European settlement of the region, those remaining either scattered across the country, living in the main townships, or joined the Adnyamatana. He added that culturally they were similar, with a common language but different dialects. On the north-east of the Ngadjuri were (as Tindale called them) the Wiljakali. The Ngadjuri called them Yandagali, again referring to stony country: most of their territory was on the New South Wales side and included Broken Hill. In general terms, Barney saw little difference between the Adnyamatana and the Wailpi (Wailpimathana) and his own group. The name Jadliaura was not mentioned.

FIGURE 4. Barney Waria (or Warrior), 1943. (WU/P17182 Photo: R. M. Berndt.)

A Land Full of Myths

The mytho-topographical perspective of the Ngadjuri was extensive. However, I mention this only briefly, mainly to provide some background to our discussion of 'the magic stick'. For instance, there were a number of spirit beings. The *wundawinyu* were fond of teasing people by throwing pebbles at them as they sat quietly in the sun or rested by their fires at night; they lived in the creeks and in the thick clumps of ti-tree. *Mungiura* were to be found in the hilly country: occasionally they would peer over the top of a windbreak, and if their faces were seen, that would indicate an impending storm. Small human-like creatures called *muripapa* danced around in circles on misty mornings; and after a couple of days, round grassy patches could be seen, made by their dancing feet. They were believed to lead people astray, even to make them mad, or to abduct their children. At night, when they usually came, people would build up their camp fires and throw sap from the *wuara* yacca bush into the flames to keep them away. *Epa-tura*, on the other hand, although they could be seen on hot hazy days, would do no harm: they were engrossed in cooking *bulkara* sandalwood grubs, and it was the smoke from their fires that caused the haze.

Generally, these spirits were said to have been in Ngadjuri country prior to the 'arrival' of the Dreaming characters: the actual sites they frequented were not specifically noted. In contrast to them was the mythic Mirlki giant who left a large footprint in a creek at a place named Mundjapi (or Mandjapi), near Mt Jibbi (or Yibbi, Mt Bryan) out from Hallett, north of Burra. In the creative era of the Dreaming, there were a large number of people living in this area. In fear of Mirlki, they fled north and entered a cave about six miles south-east of Orroroo (Ar-ru), and walked underground northward to Bukalavi (Bindalbe), near Carrieton.

Ngadjuri country, like all the Lake Eyre Basin, was criss-crossed with mythic tracks. The large Akaru (Rainbow Snake) came south from Wilpena Pound (Wilpinundu) which he/she made. Akaru was also manifested as a willy-willy (*ngadladara*).

On seeing him/her emerging from a waterhole, in this form, people would call out *'Bungari muta*!' (country/belonging to [*mata*]): and Akaru would turn away — he/she would do harm only to strangers. Like Akaru, Inawala, Perentie, came south from Lake Frome.

There were a number of myths concerning Akaru, who was invariably associated with waterholes and lakes, as well as water courses. One of these was said to have a head like a dog, with a hairy mane, and a body coloured in red and black. This monstrous Snake had a companion, a small *babulara* red snake that served to warn him/her of approaching strangers. Another, Wiperu (Whip Snake), was a well-known mythic figure who was originally in human form. He came from Tea Tree (on Lake Frome) to Tooth's Knob, where he camped. Then he went on to a waterhole, and then to a small hill (about five kilometres south of Tooth's Knob). This hill is streaked with the colours of the rainbow (*guringi*, ordinary term), and it was here that Wiperu man painted himself with ochres and turned into a *wiperu* snake. In that form he continued to Coffin Spring, where he bored a hole in the limestone cliff. This was said to be a perfectly round depression that always contained water. Wiperu had come along a salt-water creek, and the waterhole is on a raised mound: he went into that place. I was told that Wiperu was a monstrous snake, and that he lived there peacefully until a bullock came up the mound to drink. Wiperu, disturbed, emerged and attempted to swallow the animal. However, the bullock's horns stuck in this throat and he choked to death. He died alongside the waterhole. Later, his bones were collected by local Aborigines. For a time, Barney himself had the immense jaw-bone of this Snake, but this was eventually lost. Some of the bones were believed to remain in the waterhole.

Jim Mooney (see below) explained to me how all the country and rocks within the vicinity of Yunta-Panaramittee were nearly not there. Yuru (Euro) and Wudlu (or Kulu as Mooney called this creature), red kangaroo, both of the same *materi* moiety, and their respective groups, were living in the hilly country. Yuru, however, was there first and 'owned' the country; Wudlu had come later. They quarrelled. Wudlu said the country was far too rocky. 'I'm going to make it different!' So he sang all the hills and stones away. Yuru didn't know what to do; all the hills had disappeared; there were only plains. So Yuru got hold of a stray stone and blew on it — and all the hills and rocks came up again, just as they were before. That is why there are plain and hill kangaroos and euros who like the rocks. And the rocks were there for the Budla-bila spirits to engrave.

The following myth, told by Barney in February 1940, was said by him to substantiate the *vadnaba* ritual. However, it had much wider implications, one of which concerned magic.

> Two fully-initiated young men who were also *mindaba* (Aboriginal doctors) were of the *warumata*, Dreaming. One belonged to the Dieri language group, the other to the Yandruwanda; and they travelled down from their respective countries in order to introduce circumcision to the Ngadjuri. But that intention was really a secondary one. They had really left their countries to go in search of Kintjura, the spirit world, said to be located in the sky. They eventually reached Port Germein. Then they went on. It was a very windy day, and they heard a noise that frightened them. They discovered it was made by the limbs of a tree rubbing together in the wind. They named the place Inderi (referring to the sound). Continuing on, they came to Windamurlku ('white flower', so named because an 'old man's beard' creeper was growing over a black stump). When they saw this, they thought at first that it was an old man standing there: *'Y!' Yuru nakuka-idla!'* (exclamation/person/look!); *'kakati windamurlku!'* (black stump/white flower!). Going on, they came to a place where they heard the sound of someone beating on the ground. Creeping up, they saw an old man digging *yalka*, wild onions. They sang:
>
> *yalka narinyenara kunmarindma dandura*
> onions picking up shaking earth from digging
>
> They went on through scrub country, eventually coming on to a flat *bitana* plain. It was very hot, and a species of bee or wasp, *mitji-mitji*, annoyed them. At last they came to the foothills of the Mt Lofty Ranges, to a high hill called Lingyura. They had travelled the full length, from north to south, of Ngadjuri territory and beyond. They climbed the hill, and from it looked southward. They saw many people, the Lingyura spirit people. They came down, and began to walk toward them. But the Lingyura called out to them to go back. And they sang:
>
> *lingyura lingyura wunmamara wunmamara . . .*
> spirit people go back

The two *mindaba* were told they were not ready, not suitably prepared to enter Kintjura. So they turned back, but not before they received from the Lingyura certain magical objects, among them the 'magic stick'. The Lingyura, Barney said, were Dreaming spirits, not *wonggabi* (or *wungyapi*), spirits of dead persons. Eventually, the latter would find their way to Kintjura, but would, from time to time, return to their grave sites. Only *mindaba* could see these spirits, both the Lingyura and the *wonggabi*. The *wonggabi*'s association with a dead person's fat is mentioned below.

The Yarida

After his *vadnaba* and *wilyaru* (cicatrization), Barney had some preliminary training in activities

that usually concerned a *mindaba*, mainly in healing and in sorcery, although he never considered himself in any sense proficient in the latter. The knowledge he assimilated on sorcery came from his *damuti*, mother's father (pater), a Ngadjuri man named Gudjari who died in about 1900. He was the last of the old men who knew the meaning and ritual of the 'magic stick'. Traditionally, several years after a young man's *wilyaru*, and if he had shown considerable interest in magical matters, a *mindaba* with some of his colleagues would take him out into the bush (see R. Berndt 1941: 376–377). Here the postulant was red-ochred and smeared all over with dead person's fat; *windamalka* wood shavings would be placed round his head, held fast by an *angari*, or *manga* fur twine cord, and *wilka-adla* dog tails arranged so that they hung from each side of his face. The *mindaba* taught him how to bring on a situation of trance and, in that context, to talk with spirits. He was also informed about various forms of magical healing and sorcery and, especially, how to control his own spirit, how to make it leave his body during a trance. Further, he would be instructed in the art of divination during an inquest that took place after a person's death to discover who was magically responsible. It was only *mindaba* with this sort of knowledge who were in a position to handle the 'magic stick'. If anyone else were to attempt to touch it, let alone manipulate it, that would cause madness.

The two young spirit *mindaba*, as we have seen, were credited with first obtaining the 'magic stick' from the Lingyura. However, Barney said that it was really introduced into Ngadjuri country from the north-east a 'long time ago' (*widmakara*, in contrast to *warumata* that specifically refers to the Dreaming), from 'the snow country' called Bulayata. It is probable that this is the place referred to by Tindale (1937: 150, note 1) as Buthajerta (Mt Patawerta) in the Flinders Range, which he said meant in Ngadjuri 'snow country' since occasionally snow lies on this mountain during winter. On the other hand, the country around Yunta, Panaramittee, Manna Hill, as far as Bimbowrie (Bombowie), was rocky and contains many rock engravings. Among these lived two spirits named Budla-bila. They could be seen on sunny mornings, and were responsible for causing mirages (*marra-gabi*, fresh water, because they looked like that). These rock engravings were said to have been made in the creative era of the Dreaming, and traditionally there were songs associated with many of the figures depicted. The famous Panaramittee stone, identified by Mountford as a crocodile head, was said to be really a *yarida* that had been engraved by the Budla-bila. To accomplish that task they used quartz chisels from stone obtained from Waruni hill, where Eaglehawk's leg injury had festered and finally burst, and the matter from it formed the quartz deposit (see the first Eaglehawk and Crow myth below).

The *yarida* was made from a shaped piece of wood, or *wariwiti* cane was bent into the appropriate shape. In either case, specially treated human hair and possum fur twine were used. The first drawing, Fig. 5, is reproduced from the original one in white chalk on brown paper and is 30 cm in length. It was drawn at Murray Bridge in 1942, before I had obtained the original photograph and outline sketches of the engravings from the South Australian Museum. The object, if it had been made by a *mindaba*, would have measured, so I was told, 60–80 cm in length. *In toto*, it represented the spirit body of a human person, although 'within it' were many other things.

The annotation of the drawing, by Barney, is as follows. The *yarida* has a handle (1). One end of a length of human hair twine is attached firmly at (2) with *bukara-pitji*, a sandalwood gum, to the

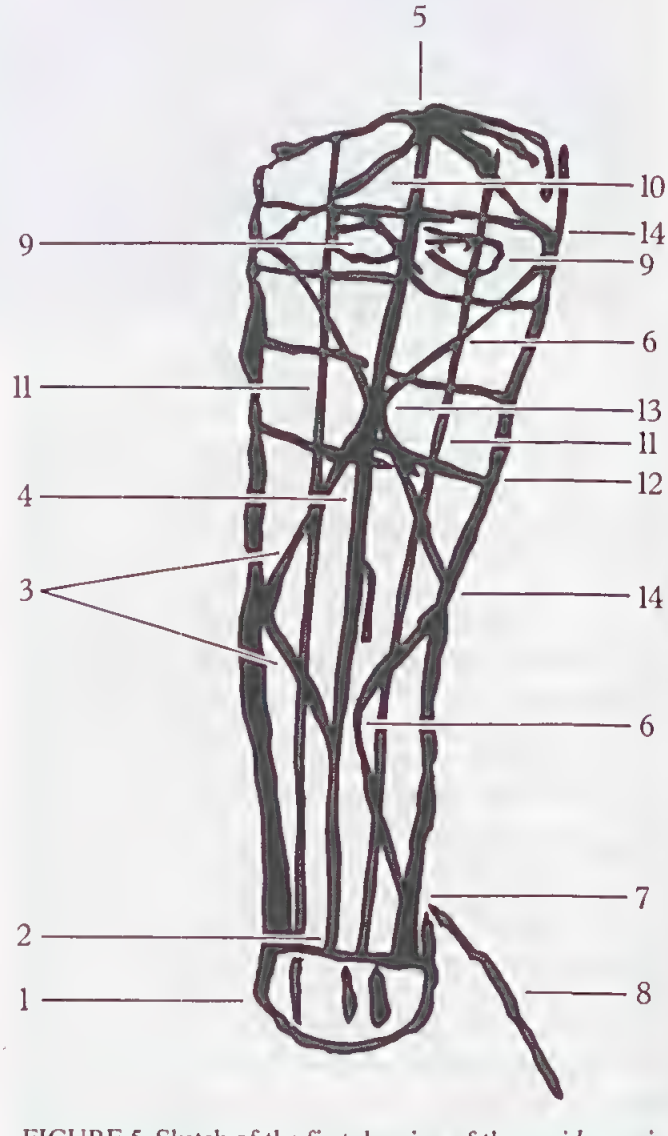

FIGURE 5. Sketch of the first drawing of the *yarida* magic object by Barney Waria, 1942. Numbered features are explained in text.

backbone of the *yarida*'s body. The twine then runs up the main trunk, turns to the left, then to the right (3), on to the left and right, linking with the *yadna-walpu*, the backbone (4), where it is again fastened with gum at (5). The twine is looped and is then taken down the right-hand side, zig-zagging (6) until it reaches (7) where it is gummed down, leaving one *akuri* hair (8). The spirit's eyes (*mena*) are (9); its *ngarada-walpu*, forehead is (10); and within the space between the two vertical lines (11), at each side of the backbone, is the *yadna-bandji*, the fleshy part of the backbone. Horizontal bands (12) are *bilda-manga*, cross-pieces of possum fur twine. The spirit's heart, *yulku*, is at (13). The human hair twine can be moved to various parts of the symbolized body, at (14), for instance: these are 'corners', located around the object, as on the left-hand side, and in the drawing they are attached to the arms (top) and legs (bottom) of the designated victim.

The second drawing by Barney (Fig. 6) is also reproduced from the original of white chalk on brown paper, and is approximately 32 cm in length. It too was drawn at Murray Bridge, but after the sketches of the engraving had been received. As will be noted, it resembles closely Figs 2 and 3. Barney took care in reproducing this, since he wanted to explain the meaning of its various sections. It too is a *yarida*.

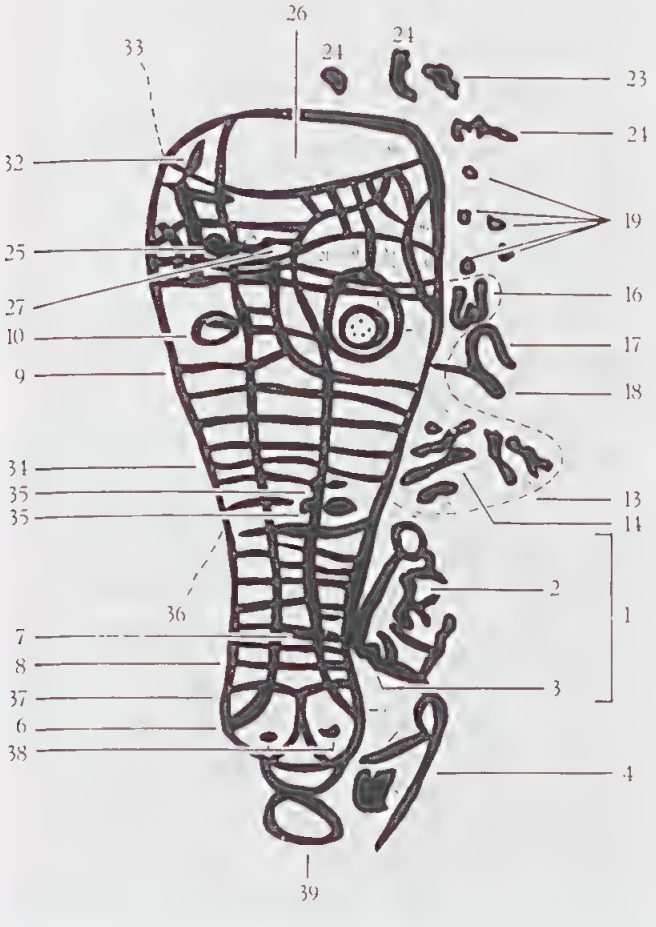

FIGURE 6. Sketch of the second drawing of the *yarida* magic object by Barney Waria, 1942. Numbered features are explained in text.

As in Fig. 5, the whole object represents the body of a spirit. Basically, there is the head (at top) and the 'handle' (at bottom). A miniature representation of a *wonggabi* spirit (manifested from a dead person's fat: see below) has been drawn in skeletal form at (1); (2) is its chest (or rib bones) and (3) its *miti*, buttocks. This *wonggabi* sits on a loose thread of human hair twine (4), while (5) represents the internal organs of a prospective victim. The length of human hair (4) joins the main twine (6) at (7) on the right-hand side and extends upward to the central body of the *yarida*, as does its companion main twine (6) on the left-hand side: these main strings are *iti-malka* (or *yiti-malka*). Horizontal lines (*malka*, marks), from (8) to (9), represent the long streaks of debris (leaves, twigs and earth etc.) that have been formed on the ground after heavy rain: they are called *wonda-malka*. The same term and meaning are associated with the long wind-blown streaks of cloud that were said to be relevant to the *yarida* — although it is not clear in what way.

Two eyes are located at the head of the *yarida*; on the left-hand side is a normal eye (10), while (11) is an outline of the hollow eye of a victim through which a *wonggabi* spirit peers after having entered the victim's body. The inner circle (12) with its dots is called 'the face' — *wonda-kunyu-mangu* (spirit-white-face) — referring to that of the *wonggabi* of the *yarida*: the dots refer to two eyes, *mena*; the nose, *mudla*; cheek bones, *ngulkana*; and mouth, *yaga*. The area between the rim of (12) and (11) is the *mena-batu*, swollen eye, when a victim becomes hollow-eyed during illness.

The area marked (13) is associated specifically with female victims. A leg, *yalku-atuni* (leg/woman) is depicted at (14), with *waltjeri* (15), intestines and/or entrails; and *aka*, vagina (16). A length of hair twine is placed on a woman's leg, to cripple her temporarily — if she has been running about after men. A *biri*, a fibre or twine hook is placed at (17), and immediately beneath it a *karawalpu* club (18) that is used to kill a person by striking a heavy blow at the back of the head. Like all aspects mentioned, they are anointed with dead person's fat. Five marks indicated (19) are *gudna*, excreta of a victim, mixed with human hair, red-ochre and dead person's fat. This really symbolizes excreta (faeces) of the mythic Crow, and also has relevance to the Milky Way (see below). However, these same marks are also said to be the tracks of *iti-iti* (or *yiti-yiti*), a small lizard that has this design (*iti-malka*) on its body. In early mythic times, Iti-iti was a man, a great climber of trees; he is associated with this form of sorcery. But the marks can refer to a man stepping along lightly, like a child. Its basic meaning is said to concern Crow.

Above the hollow eye (11), an area (20) divided

vertically by a piece of twine represents a 'club' foot, an *idnabatu* (or *yidnabatu*) that has been eaten away by disease magic; the calf is at (21), and the heel, *maku*, at (22). The penis, *wari*, is shown at (23), and (24) represents three different bones from a human skeleton. The temple, *winggu*, of the spirit's forehead, *ngarada-walpu*, is drawn at (25) as a circle. From (25) running right is a representation of a *mindi* cat's-cradle (27) that is under (that is, within) the top of the spirit's head (26) — from (28) to (29), across; from (30) to (31) downward, across and including the *winggu*. This *mindi* is really a net in which a victim may be caught. The *winggu*, however, is also located in the Milky Way as a black area, while in the same constellation the *winda-gudna* is Crow's faeces: this takes two positions in the Milky Way. It is on the eastern side during winter, on the western side during summer. A large black patch is the spirit that comes to a *mindaba* 'when the Milky Way turns' and helps him in his act of sorcery. The main strings (6) of the *yarida* represent tracks of mythic beings — for instance, the Budla-bila as well as Crow and Yulu, Kingfisher — who travelled in Ngadjuri country. The myths associated with them were re-told from one *yarida* twine-join to another — that is, from (8) to (9), from one horizontal band to the next, until reaching below the eyes, (10) and (11).

On the top left-hand side, 'a kind of creature' is shown (32); this is a slate-grey small *buli* bird regarded as being important in magic. It was also suggested that this could be Yulu as a human being: he was the mythic patron of the *vadnaba* or *malgara* circumcision rituals and responsible for introducing them.

At (33) is what Barney called the loose end of the main body of the *yarida*. In Fig. 6 this is drawn in with broken lines, and represents a hair from the twine. The horizontal and vertical strings form the backbone and the ribs (34) of the spirit. *Manga* fur twine is fastened and tied at (35), and is represented by two pairs of ovals: these may easily be untied and moved to any part of a victim's body. A further loose end (36) was indicated by Barney, as in the case of (33). The *akuri (or akadi*, head) human hair twine (37) runs through (or is threaded through or tied to) all the other strings, holding them together (that is, the string that surrounds the whole of the *yarida*). There are two holes (38) through the wood or *yarida* frame, called *wadju*, nostrils, through which the string(s) is/are threaded in order to be brought up the backbone of the *yarida*. At the bottom (or handle) are *ngaldja*, bubbles of saliva or froth (39) coming from the victim's mouth as he lies dying: or, on some occasions, spittle that can be collected for use in sorcery.

As will be appreciated, although this description of the significance of the *yarida* is reasonably detailed, it could no doubt have been considerably elaborated if Barney had been brought up in a living-traditional context. As it is, there is sufficient information to substantiate his contention that Mountford's 'crocodile' was in fact a *yarida* — at least to him, whatever it may have been to his early ancestors or to the Budla-bila! In a way, the *yarida* is a small graphic 'handbook' on sorcery: but not entirely so, since it also provides clues to the wider frame of Ngadjuri religious belief, referring as it does to mythic characters and, especially, to the re-telling of their adventures by way of the object's strings.

How the Yarida was Used

While use of the *yarida* is already noted in its description, Barney's grandparent, after having made it, would hold it up by the 'handle' and speak to it. *'Yura nakuga anawatin mangguga!'* (man [name]/you see/that one/catch him). Talking to it, and repeating *'Yura mangguga!'* (Catch a man!) he felt the strings trembling in his hand: 'They seemed to tell him, "Yes" '. The *yarida* knew what man to get! Then he put the stick away, hiding it. Later, on a pleasant sunny morning, he took out the *yarida* and put it in the sun (*dendu yundunga wondakalu* [in sun/on ground/he puts it]) to warm it. 'The spirit of the *yarida* is looking for the victim' (that is, searching for him or her). Already the string has been placed on a particular part of the victim's symbolic body; the spirit finds the victim and enters him, and his/her illness commences. He/she becomes increasingly ill (*mingga*) and dies (*yindatha*).

After a successful undertaking, the sorcerer smears ('paints') the strings of the *yarida* with dead person's fat and red-ochre: *Wudlu yakuda mangkukal ngudla kalu yarida wondakalu* (kangaroo skin/bag/he got/put/into/magic stick/put away). When not in use, it is wrapped up in possum fur and tied up with red-ochred twine. Elaborating, Barney said that when his grandparent used the words *'mangguga anawalthuna yura mangguga!'* (catch him/that one there/man/catch) he feld a shock run down his hand from the string he held: this indicated that the *yarida* spirit had left the object and had hit the victim. His grandfather promised to give Barney his *yarida*; he knew where it was hidden in a cave, but did not tell me at what place. He told me he would get it and give it to me. However, soon afterward he returned to Point Pearce and I went north to carry out further anthropological research.

In short, then, to operate the *yarida*, a sorcerer held it in his hand or placed it before him on the

ground; or, sometimes, put it on hot ashes protected by a bed of green boughs. The heat intensified its magical potency. A *yarida* string had to be placed on the appropriate limb or part of a victim's body represented in the object's design. As the *yarida* was manipulated and special songs were sung (songs that Barney, unfortunately, did not remember), the *wonggabi* spirit left the *yarida* by way of the relevant length of string and went directly to its quarry. If a string indicated the victim's heart, death would be instantaneous. Alternatively, if a string indicated a gradual illness, it was said, that would 'wear you down to skin and bones, you just couldn't recover!'.

The Arena of Sorcery

An essential element in the performance of this form of sorcery was dead person's fat. Unless the strings were anointed with this substance, the magic would not be effective. Moreover, without the anointing of the strings and the object, the *wonggabi* spirit could not be present to carry out its allotted task. That spirit entered through the fat. In other words, it was the spirit of the dead person himself or herself, seeking to avenge his/her own death or injury, under the control of a *mindaba*.

In ordinary circumstances, Barney said, Ngadjuri removed a little fat from a deceased person's stomach and it was eaten by his/her close relatives, especially by grandchildren. Belief had it, that the deceased's spirit would enter the eater's body and protect him or her where need be. However, the human fat used in sorcery was not of this kind. It had to be removed from a person killed by sorcery and/or in the course of a revenge expedition. This meant that the fat was obtained through a magical operation before the victim died. The fat was then left to dry, wrapped in bark or grass and kept hidden away in a cave to become putrefied, when it could be used.

Barney mentioned a case that had occurred at Burra when he was a young man. Bita people (as he called them; probably Tindale's Ngaiaweng) from Morgan on the River Murray came to attend ceremonies (generally called *kuri*) arranged by the Ngadjuri. Instead, there was a lot of talk concerning suspected deaths through sorcery, accusations were made, and fighting broke out between the two groups. Some Ngadjuri men went over to the Bita 'mob' and killed and injured several of them without giving any reason for doing so. A further meeting was arranged later to find out why they were killed. In retaliation, the Bita sorcerers attempted to preform *mildina* (called 'bruising' and referring to the form of sorcery that involved pounding a victim's chest with a club). After much ill-feeling, the matter was resolved by holding a *kopara* (a widespread term in the Lake Eyre Basin also used by the Ngadjuri, for a ritual resolution of conflict: see R. Berndt 1965: 183–186). Fat that could be used in *yarida* sorcery was removed from the persons killed in this fighting.

In another example, said Barney, a man named Old Graham was sorcerized by *mildina*. Apparently, this happened at Port Germein in Nukuna country. On returning to Clare where he lived, he became ill and lay down in his camp. He was so obviously sick that his relatives took him to the Clare hospital. I was told that the European doctors who attended to him were at a loss to know what was the matter with him. After a few days he died. However, they asked a *mindaba* (I believe this was Barney's grandfather) to diagnose the cause of death. With the permission of the European doctors, the *mindaba* cut open the dead man's stomach and reported that his intestines were tied up with grass fibre and that among them were fragments of crystal and broken bottles. The *mindaba* also observed that a hole had been made on the left-hand side of the stomach, a bone having been inserted to extract kidney fat (*wirumani* or *wangamani*). That fat was later used in sorcery.

In general terms, the fat could be drawn from either side of a victim's stomach by using a *baya* kangaroo bone, or from the *mindati*, navel. The *baya* was inserted and twisted to remove the fat and, in the case of a navel, the aperture was tied up with *andu-ildja*, wallaby sinew (*gandu*, rock wallaby); in other cases, the hole was simply smeared over with earth or red-ochre. It was also said that the entrails of a victim under the influence of sorcery could be removed through the *adna-wadju* (or *mundu-wadlju*), anus, when foreign substances were placed with it and then put back after tying up the entrails. In these circumstances, needless to say, the victim could not defecate (*gudna*), and would soon die.

The fat was usually removed, so I was told, at night under special conditions (see below) and in some cases a bone needle called *walpu* was used. The victim was first rendered unconscious by a blow on the head with a *tandanaka* club previously 'soaked' (anointed) with dead person's fat. The club was spoken of as 'a magic stick', so that the blow need not be hard. As Barney said, ' it is the spirit of the fat in the "stick" (club) that does the trick'. The victim was then placed on his back, and his tongue pulled out and a pointed stick or needle pressed into it. The two or three *mindaba* who might be present spoke to the unconscious man: *'utna wongguga'* (don't/tell anyone). 'That victim knows who has caught him, but is unable to tell anyone.' The kidney fat was then removed.

Such acts of sorcery should be carried out only when the Milky Way, *walibari*, is propitiously placed (see Fig. 6): that is, before it is 'about to turn',

when all people (except sorcerers) were said to be asleep. The same belief was also current among Wuradjeri and contiguous groups. (See R. Berndt 1947: 69.) The time would be after 1 a.m., 'because then a person is not himself or herself, his/her spirit has temporarily left its body; or, if not then, after 4 to 5 a.m., again, when everyone is sleeping soundly. Between 11 and 12 p.m. and a little before 4 a.m., it was the habit of old men to keep watch for sorcerers — 'when the Milky Way was beginning to *wailiku*, turn'. There was also a reference to a person 'turning' in his sleep, which the old men prevented him from doing. However, I don't understand the allusion. It was when all the people were asleep that sorcerers were said to be on the prowl, to approach their victim, and by using a long human hair cord, to loop it round his arm and steadily draw him away from the camp. It was the spirit within the cord that carried out this task. Once away from the camp, a *mindaba* would knock the victim on a small bone called *nundi-walpu* located at the back of the head and render him unconscious. After the kidney fat had been removed and the aperture sealed, the victim's ears would be pulled and blown into, to prevent him from hearing anything. The *mindaba* would hold him from the back and tell him, *'anggurukaka!'* ('Go home!'), pointing in the direction he should take and the victim would return, unsuspectingly, to his own camp. Within three days he would be dead.

Barney had had (he said) a narrow escape while camping as a young man in the Orroroo district. He was with an old man named Bunlipari and some young boys. They had made a *walanga* windbreak. Bunlipari slept at one end and Barney at the other, with the boys in the middle in front of a fire. At the turning of the Milky Way, a sorcerer came sneaking, looking over the windbreak at the sleeping group. He threw a stone into the fire (*watugaii adnya manggugala wiakalu*; looking over/stone/picked up/threw) to make sure no one was awake. Bunlipari and Barney awakened and saw the sorcerer peering at them. They lay quietly, without moving. The sorcerer came round to Barney's side and bent over him, ready to place his hair cord over Barney's arm. At that moment, both Barney and his companion jumped up: Barney was not quick enough and Bunlipari was too fat, the sorcerer escaped — *nakun yura iwana angurikai yudlina batili-bariku anggura* (saw him/man/standing/jumped up/chased [him]/quickly got out of sight [*bati* referring to an insect that scuttles away]/went home).

Some Points of Relevance

In the course of our discussions, Barney said that the Adnyamatana were associated with the Guyani and often held meetings at Beltana. It was from them that he heard of another 'magic stick', a crystal one that was called *maimu* and had the same properties as did the *yarida*. It too was smeared with dead person's fat, and through it the *wonggabi* entered the object. When it was held by a sorcerer and thrown outward in the direction of a named victim, its magic would pierce him or her 'like a bullet'.

I was also told that, although the Ngadjuri *yarida* was primarily 'death-dealing', it could be used for curative purposes as well. For instance, in cases where death to a victim was not intended, its power could be negated by removing the string from the part of the victim's body represented on the *yarida*. Further, more direct cures for sickness not attributed to sorcery could be effected, by placing a string on the relevant part of the body represented on the *yarida*. However, the string had to be free from any dead person's fat and, instead, smeared with emu fat — and that fat was also rubbed all over the afflicted person's body. This procedure was said to cure severe sores, smallpox and leprosy.

In spite of this positive side of the *yarida*'s power, it was its malignant aspect that was emphasized. One day while I was sitting talking with Barney in Light Square the matter of Lasseter's reef was raised. Barney had visited Oodnadatta and someone had told him about Ion Idriess's book, 'Lasseter's Last Ride'. 'You know, Mr Berndt, those prospectors went out to find Lasseter's reef. They never found it, because that *yarida* made them mad, confused; they couldn't find their way to it'. At the time I had not read that book and, in fact, it was only when writing this paper that I thought I should do so. The references to 'the stick' appear in Idriess (1948: between pages 69–93). However, it seems fairly clear that 'the stick' noted there is not a *yarida*but a long secret-sacred board; although it was certainly interpreted by Barney as the *yarida*. (I should mention that Barney was not literate and was told about the Idriess book by a friend.)

Further Mythological Background

Mythic Eaglehawk was associated with the Panaramittee engravings; and, as far as the *yarida* was concerned, so was Crow. It seems relevant therefore to give two versions of the Eaglehawk and Crow myth. Moreover, Tindale (1937: 151–152) also recorded the Ngadjuri one I present here from Barney. It is, therefore, of some interest to compare this version with Tindale's, both from the same man. The second Eaglehawk and Crow myth I give here is related to Broken Hill and was recorded from Jim Mooney.

In the Ngadjuri one I wrote down, all creatures were human beings in the Dreaming. Wakala, Crow, a *gararu*

moiety man went out hunting near Orroroo with Wildu, black Eaglehawk man who was of the *materi* moiety. They obtained meat, but Eaglehawk was greedy and refused to give any to Crow. Crow was jealous of Eaglehawk because he was strong and able to crush the twig and stick 'nests' of the *wada* (*gararu* moiety) 'house-building' rats. He therefore obtained a kangaroo leg bone and, sharpening it at one end, placed it carefully among the twigs of a rat's nest with its point upward. Crow spoke to the bone, telling it that when Eaglehawk came along it was to move about in order to make him think that many rats were hidden in the nest.

Crow called out to Eaglehawk to look at the nest he had found. He came along, and seeing movements within it, jumped on the nest. The sharpened bone (*baya*) pierced one of his feet, causing a severe wound. Seeing this, Crow laughed and ran away to Malkara (near Minburra, north-west of Yunta). Eaglehawk struggled back to his camp. His wound began to fester. Nevertheless, he was able to hobble on, following Crow's tracks. (Crow was, apparently, accompanied by his family.) He followed Crow to Yunta and from there, finding Crow had moved on, went westward to Waruni (Waroonee, a little north of Yunta railway station). A light rain began to fall, and looking round for shelter Eaglehawk saw a cave. However, this was occupied by Crow and his family, and when they saw Eaglehawk coming Crow shouted out to him, 'Go away, your foot smells!'. So Eaglehawk went some little distance away and gathered *nala*, spinifex or porcupine grass, and carried it back to the mouth of the cave. The rain had stopped, and Eaglehawk piled it up all around and set fire to it, throwing on green grass to make a dense white smoke. He smoked the Crow and his family, and they turned into birds; that is why they are now called *wakala or mena-balkara* (*mena-nalkara*), 'eye-white', and they are black from the fire Eaglehawk made.

Eaglehawk, however, hobbled over and sat at the side of Waruni Cliff. His sore leg was itching, so he scratched it. The pus, *gaba*, burst out and ran down the side of the cliff. Today, it is metamorphosed as white quartz (*yudla-gadna*). It was this material that was made into chisels and used to engrave the rocks of this area. Eaglehawk then turned into a bird.

Eaglehawk's father, Mura, Red Hawk of the *gararu* moiety, had in the meantime been hunting rats, cutting up the meat and cooking it — because he knew what would happen. His son came swooping down from Waruni, calling out, 'Where are all the people? I want to eat them!'. His father replied, 'Don't eat people, eat rats!'. And he threw up a piece of rat's flesh that his son refused to eat. Eaglehawk swooped down three times, crying that he wanted human flesh. Each time, his father offered him rat meat; at last he ate some. 'That is why Eaglehawk swoops down for his food!'

While the two versions, Tindale's and mine, are reasonably close in their renderings, there are some interesting differences, and one of these concerns using the quartz for rock engraving. Crow, too, was said to be a cunning creature. He preferred to injure Eaglehawk by means of a ruse instead of by direct confrontation and, although this is not mentioned in the myth, used sorcery to achieve his goal.

The other Eaglehawk and Crow myth was given to me by Jim (James) Mooney with whom I worked, mainly on genealogies, in March 1944. He was born at Bimbowrie station, north-east of Manna Hill, in 1864. His father was Bob Mooney, a European who worked on that station; and his mother was Jane or Jinny Yalta-yalta or Yalta, meaning 'many stones or a stone', since she had been born in the stony country of the Wilyakali (Wiljakali). However, Barney said she was a Ngadjuri and had been born at Black Rock in Yamba-muta country near Broken Hill, named Wilyama Hill, 'where all the silver came from!'. The story Jim Mooney told is as follows:

A quarrel had begun between two mythic beings and members of their respective groups. A large meeting had been called, and all the creatures who attended were human beings in the Dreaming. One group were all of the same matri-moiety, *materi* or *makwara* (the eastern term) to which Wariku, Eaglehawk belonged; and the other moiety group was *gararu* or *kilpara* (the eastern term) to which Wokala, Crow, belonged. The two groups were arguing. Eaglehawk accused Crow that he and his group were not following 'the old Law'.

(Mooney told me that Wokala, also called Ku-eiyara, the light-eyed crow of the *kilpara* moiety was different from Waaku, or Wagu, the dark-eyed crow of the *makwara* moiety.)

It all arose from a large number of people dying; at first, more men than women; then more male children were being born, and more female children were dying. More women died, and many men were left without wives; many women were left without husbands. At this time, too, people married within and not outside their moiety categorization; no one could marry a person of the opposite moiety — that was Eaglehawk's Law. Eaglehawk did not want people to die.

One person got up and spoke to Eaglehawk. 'Why shouldn't these people die? If they have to die now, they can come back later after a certain time!' [That is, be reborn.] 'No,' replied Eaglehawk, 'They must come back!' [That is, in the same form as when they died.] So they continued to argue. At last Crow got up and said, 'There are more men than women in one of our groups, why shouldn't we marry them? [That is, from outside our group.] If one of our "religion" [that is Law, moiety group] dies, let him or her die and his "tribal" brother can take his widow as wife; or the husband find another wife!' Eaglehawk, however, would not agree: he wanted a man on dying to return after three days to his own wife; or a wife on dying to return to her own husband. The quarrel continued; nothing definite was decided and the meeting broke up.

Sometime afterward, Crow came on Eaglehawk's camp in the course of his travels. Eaglehawk had gone out hunting and left his son behind: he was preparing the meat his father had caught. Crow said to the son, 'I'm very hungry, will you give me some of that meat?' 'No,' the son replied. 'How will he know some has gone? I only want a little bit!' Crow asked. 'Yes, he will know,' the son answered. 'If you eat some of that meat he will know. He uses a spear in hunting for his meat and if you were to eat some his spear will break!' But Crow took no notice, he grabbed some and ate; then he took

more and finished it all up. He told Eaglehawk's son to go down to the creek for water. While he was away, Crow picked up a stone which he made red-hot in the oven's ashes. On his return, the boy looked round for Crow, but couldn't see him. 'Where are you?' he called. 'Here I am,' answered Crow. 'Where?' the boy called again, holding his head well back, calling out and looking around. Crow began to sing and the boy danced toward him. 'Look up!' Crow said. As he did so, Crow threw the red-hot stone into the boy's open mouth, choking him. He died.

Eaglehawk's spear had broken, just as the boy had said it would. He knew that something had gone wrong at his camp and hurried back. In the meantime, Crow had re-arranged the camp, putting the boy's body by the fire, making track marks to indicate that fighting had taken place and breaking up some clubs and spears. It was all ready for Eaglehawk's return. Crow met him and in a sad voice said that this was how he found the camp on his arrival: 'Some stranger group must have come along and killed your son'. He showed Eaglehawk the tracks and pointed out that all the meat had gone. Eaglehawk thought to himself, 'Ah! what a liar he is. *He* did this. I'll bide my time. How can I get him? I must make a plan!' That night it began to rain. Eaglehawk made a brush and bark hut for 'poor old' Crow to sleep in. Then he prepared one for himself, nearby. In the night, when the rain had stopped, he made a fire brand and threw it into Crow's hut. The flames burnt the hut and Crow to ashes. In the morning, Eaglehawk looked and saw that he had made a thorough job of getting rid of Crow.

Some little time afterward, Eaglehawk went out hunting and caught a rat. He brought it back to his camp, near the ashes of Crow, and cooked the meat, thinking in sorrow of his dead son. He took the meat out of the oven, ate it and threw away the bone. He looked over to where it had fallen: it had disappeared. Then he threw another bone, and it too disappeared. Next time, he threw a bone with some meat attached; again it disappeared. He went on throwing these. Crow's spirit was eating all these pieces of meat and bones: his spirit had not died, 'you can't burn or destroy the spirit!' His spirit had remained at the place where his body died. Crow's spirit was absorbing all that meat and those bones and gradually, unseen by Eaglehawk, he was regaining his material form.

After Eaglehawk had finished eating and Crow had absorbed all the left-overs, a whirlwind came running in the direction of the camp. Crow stepped into it, and as it came to the place where he was burnt, it gathered up all the ashes which Crow absorbed. In his true form, he jumped out of the whirlwind, calling '*Wa*! I'll have you now!' But Eaglehawk had run away.

Some little time later, Crow came to Eaglehawk, having tracked him to another camp. In a plausible manner, he told him of a large rat in a grass nest. The usual way of obtaining these creatures was to place a foot on the nest while a spear was thrust within it. Crow said, 'My foot is too small; yours is large enough!' Eaglehawk went with Crow to where the nest was. Crow had already prepared a pit trap, placing upright spear-pointed shafts within it, hidden by grass. Eaglehawk put his foot on the 'nest', but it collapsed, causing him to fall in to be pierced in the legs and body by the spear-points. This happened at Wilyama Hill. Eaglehawk died there, his blood flowed, spreading in streaks across this area to form the silver deposits at Broken Hill. That country is Crow country and the people there follow his Law. They have inter-marrying moieties; and men and women, once they are dead, do not return to their wives and husbands, as Eaglehawk would have wished. Crow was eventually killed about twelve miles north-west of Broken Hill at an outcrop called Black Rock, Pernumuta, where he was burnt in his hut.

Unfortunately, Jim Mooney did not remember the place names associated with these mythic events — except for Black Rock and Broken Hill. He added that Eaglehawk's variegated feathers explained the reason why there were differently coloured stones and rocks at Broken Hill and in the vicinity.

Although in this myth the *yarida*, or for that matter sorcery, is not mentioned, both Barney and Mooney saw it as being integral to understanding the overall mythological background of the area. Crow was associated with sorcery, although not in this case. Rather, interpretation was at a different level. In this early Dreaming period, people could have made the choice between death and returning in the same form as before: in short, between dying or not dying. If Eaglehawk had not been killed, then there would have been no sorcery, and no death. Since both were killed, a choice could no longer be made; the way was open to sorcery!

This is not the place to embark on an analysis of the content of each myth, except to say that each mirrors interpersonal conflict that cannot necessarily be resolved — except through physical aggression or through the devious practice of sorcery. As will be known, the classic conflict between these two mythical personages is widespread and manifested in many Eaglehawk and Crow stories. In passing, it is worth mentioning that Tindale (1939: 243–261) presented an Eaglehawk and Crow myth from the 'Maraura' people of the lower River Darling. There are few resemblances between his and the one I give, except that in Tindale's the death of Crow's sister's son is mentioned (pp. 253–254). What is of particular interest is that there is an echo of the original dispute between Eaglehawk and Crow concerning matrilineal or patrilineal descent and its implications in marriage (p. 258).

Conclusion

In conclusion, I should say that this paper is intended to present an Aboriginal interpretation as an alternative to what has come to be known as the 'Panaramittee crocodile' rock engraving. It does not dispute the assertion that the design on the relevant piece of rock could originally have been something

different. There is no doubt that it 'looks like' a crocodile's head. But equally persuasive is the assertion that it is something entirely different. The evidence that was given to me by Barney Waria, in some considerable detail, leaves little doubt in my mind that the engraving did represent, or was identified by Aborigines as representing, what was called by them a magical *yarida*, a powerful object that could be death-dealing as well as possessing the potentiality of curing a sick person. However, it is the 'dark' side of the *yarida* that has been emphasized.

As far as I know, there is no reference in the literature of Aboriginal magic and sorcery to a similar object being used. Nevertheless, the context in which it was discussed and the rationale of its method of use are entirely consistent with what we know of Aboriginal magic. The *yarida* is in fact unique, and the recognition of its being a 'magic stick' is important. It has a substantiating mythological basis, a typical and established technique of operation, and it is set within a matrix of magical knowledge, especially in regard to the use of dead person's fat. All that gives it a ring of authenticity.

Acknowledgments

I take the opportunity to dedicate this paper to the memory of my old friend, Barney Waria. Perhaps, if Eaglehawk had not been killed by Crow, we would have had a different story to tell!

I wish to acknowledge also the help of the South Australian Museum in supplying me with a photograph of the Panaramittee engraving and sketches of its design, during my early fieldwork in South Australia.

Dr John Stanton, Curator, Anthropology Museum of the University of Western Australia, kindly prepared Figs 1, 4, 5 and 6 as well as the original sketches (Figs 2 and 3) of the Panaramittee 'crocodile'.

I should like to acknowledge the helpful comments made by Dr Luise Hercus on reading my contribution. They concern linguistic matters and I have been able to accommodate to some of them. However, it is necessary for the reader to note that the orthography I used in the 1940s was based on G. Noël-Armfield's 'General Phonetics' (Heffer & Sons, Cambridge, 1931: 21–24). Moreover, I have not appreciably changed the spelling of words I wrote down as Barney spoke them. To do so now, in the 1980s, would be in my view unethical. In such circumstances, I have retained both voiced and unvoiced consonants (p, t, k and b, d, g) as I heard them. In a couple of instances I have used 'th' as in *th*in (see Berndt & Vogelsang 1941). It is possible, as Dr Hercus pointed out to me, that Barney mixed Ngadjuri with Adnyamatana. Indirectly he implied this, since by the time he was a young man the number of Ngadjuri speakers was drastically depleted and they were inevitably interacting with Adnyamatana people. I did not, in the 1940s, distinguish between the three 'r' sounds. Further, it would appear that I have occasionally used the symbols 'a' and 'u' interchangeably. I can only repeat that I recorded what I heard. In regard to my use of hyphens: I have used that device mostly to separate parts of a compound word or phrase, as in *yadna-walpu* and *yadna-bandji*, etc. I have no explanation to offer as to why the hyphenated term *Epa-tura* was used for a particular kind of spirit. As Dr Hercus notes, *tura* is a Banggala-Guyani term equivalent to *yura* or *epa* in Ngadjuri and means 'human being'. The implication could be that this spirit has *no* human qualities, that it is *not* human. As far as the use of *baya* (or, as I spelt it earlier, *baija*) is concerned, it was not translated as 'bird' but referred to *any* sharpened bone, whether it was a bird or kangaroo bone.

I am indebted to Dr Hercus for having pointed out that the term *yarida* is/was widely used in the Lake Eyre Basin. For instance, she noted that the Arabana-Wangkangurru used it to refer to 'evil magic' or 'poison', and not specifically to a sorcery object. The influenza epidemic of 1919 was referred to as being *yarida*. However, I did not record that word as being used in a general sense. But Barney did mention that *yarida* was used for a crystal throwing or pointing object that he called *maimu*: he drew this in chalk for me on brown paper. I would like to have followed up that point in other published material for the Lake Eyre Basin: for instance, to have gone through my bundles of Dieri texts. But all of that would have expanded this paper far beyond the space permitted. My cases of sorcery are restricted to what Barney told me. Nor was this the place, for example, to follow up 'birth-order names' (of which Barney's own is an example) and Ngadjuri social organization.

Finally, I have purposely refrained from including any of my interlinear texts, because I was not sufficiently proficient in Ngadjuri to have any control over the language — and, especially, after more than 40 years! In the renderings of some of Barney's statements, and his and Mooney's myths, I have used ordinary English. Barney spoke reasonably good English and *not* what is now called Aboriginal-English. Although he was non-literate, that by no means impaired his English expression; Mooney was literate. In my note books concerning their information, I recorded the gist of what they said, with many actual quotations. The statement by Barney on the first page of this article originally read, 'It's wonderful. Here we can look at all these things stacked up all around! People come and look at them — but they don't know what they are. We do! It's wonderful to think of their power, of all the songs and corroborees they had. Now all that's gone! All that's left is only in the thoughts of some of us'. And that just about sums it up for the majority of us.

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THE FLINDERS RANGES: A PLEISTOCENE OUTPOST IN THE ARID ZONE?

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This paper presents preliminary results of recent archaeological survey research in the Cooper Basin, Strzelecki Desert and the northern Flinders Ranges of South Australia. The results suggest a pattern of late Pleistocene occupation of the Ranges followed by movement onto the surrounding plains as climatic change allowed, leading to late Holocene occupation of the entire Lake Eyre Basin. It is hypothesised that movement such as this may also have occurred prior to 22 000 BP with increasing aridity forcing moves back into the better-watered Ranges.

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The Flinders Ranges are a series of mainly quartzite ridges running north–south, extending northward from the Mount Lofty Range and eventually petering out in the dunefields of the Strzelecki Desert. The northern sector of the Ranges contains some of Australia's more spectacular landscapes, with jagged peaks, razor-back ridges and deep gorges. Here, the sharp relief of the Ranges contrasts markedly with the surrounding sandy and gravelly plains. Across these plains to the east lies Lake Frome, and to the west Lake Torrens. Both lakes are large saline playas, containing water only rarely. Northward lies the vast expanse of the Lake Eyre Basin, where drainage flows from more than a million square kilometres of arid country to evaporate from the saline flats of Lake Eyre.

The northern Flinders Ranges have an annual rainfall of slightly less than 300 mm, which decreases from south to north, and is 50% greater than the nearby plains which receive only 200 mm. This diminishes to a mere 125 mm in the heart of the Strzelecki Desert and at Lake Frome. Within this parched region the northern Ranges are thus a reasonably well-watered strip of land.

As well as having a higher rainfall, the Ranges have deep shady chasms with a rocky substrate that retains surface water in pools after the streams themselves have ceased flowing. The plains by contrast have only highly ephemeral streams and salt pans, plus a few widely-spaced artesian springs with water that is not always drinkable. The streams flowing from the Ranges after rain often begin at a high discharge, but on reaching the plain, peter out rapidly, only rarely reaching the lakes, Frome and Torrens. Under this regime, the streams drop their bedload sediments within a short distance, forming alluvial fans on the piedmont.

Perceived research potential

In 1979 we made a wide-ranging field reconnaissance of the Cooper Basin, Strzelecki Desert and the northern Flinders Ranges (Hughes & Lampert 1980, Lampert & Hughes 1980). At that time there was much speculation, but little information about the antiquity of Aboriginal occupation of deserts in and around the central core of the continent (cf. Bowdler 1977). We saw potential rewards in seeking stratified archaeological materials in sediments for which suitable antiquity was either known or could be expected: linear dunes with Pleistocene cores but mantled with recent sand in the Strzelecki Desert; alluvial fans in the northern Ranges; lunettes around lake margins throughout the region. Our interest was directed to the region also by reports of Kartan assemblages in the Ranges (Cooper 1943). Following Lampert's earlier research on Kartan sites on Kangaroo Island and mainland areas nearby (Lampert 1981), a reconnaissance of the Ranges promised to establish the northern limits of the Kartan industry, which had been identified as a regional variant of Australia's early stone tool tradition. There was a possibility also of locating the industry in a stratified context, particularly in the northern Ranges where numerous exposures had been cut through the Pleistocene fan deposits by streams (Lampert & Hughes 1980).

Research Results

1. Cooper Basin — Strzelecki Desert

At least one hundred archaeological sites were found around lakes and claypans, and along ephemeral water courses. All are late Holocene judging

from the ubiquitous presence of such typical small tools as tulas and microliths, and of seed grinders, all associated with surface sediments. Core tools and largish flake tools are rare, and no artefact was located unequivocally in the compact lower dune sediments, for which dates of around 15 000 BP have been deduced (Hughes & Lampert 1980).

However, Wasson (1983 and pers. comm. 1986) obtained a date of c. 13 000 BP for charred wood from a small Aboriginal fireplace, containing mussel shell and burnt clay but no stone artefact, found near the centre of the Strzelecki Desert (Site JSN, Fig. 1).

Only at Lake Murteree (Fig. 1) did stone tools seem to be eroding from old dune sands. Our expectation of this being a Pleistocene site was strengthened by its location: beside a reliable water hole and an extensively quarried outcrop of silcrete. This seemed an ideal spot for long term activity. However, excavation during a subsequent field season showed that the artefacts lay only in a slope-washed skin of sediment on the eroded sub-dune surface and not in the dune core itself. The absence of early, stratified material at this promising location supports the hypothesis of late occupation of the area, the fireplace found by Wasson denoting a fleeting visit towards the end of the Pleistocene.

2. Mound Springs

These natural outlets for water from the Great Artesian Basin lie in an arc several hundred kilometres in length stretching from Lake Frome to Dalhousie just north of Oodnadatta. During reconnaissances to investigate their archaeological potential (Hughes & Lampert 1985, Lampert 1985), each major spring complex was found to have at least one large camp site associated with it. Like the site described above, they are late Holocene in age on the evidence of both stratigraphy and the predominance of typical small tools in assemblages. Artefacts had been deflated from recent sediments and let down on earlier, more compact horizons such as carbonate palaeosols or the late Pleistocene cores of dunes. However, at three sites, West Finniss, Welcome and Dalhousie, a few artefacts were seen emerging from a carbonate palaeosol horizon just below the surface, suggesting the possibility of occupation earlier than the late Holocene.

3. Lake Frome

The lake is a saline playa some 100 km long and 45 km wide. With an annual rainfall ranging between 100 and 125 mm and an evaporation rate exceeding 2200 mm, it is one of Australia's driest places. Surface drainage from the Flinders Ranges to the west and the Olary Ranges to the south brings water as far as the lake only rarely. Occasionally, the overflow channel from Lake Callabonna to the north brings water derived ultimately from Strzelecki Creek, but only when there is major flooding in south-western Queensland.

A few surface sites are located along the western shore of the lake, all characterised by largish flake and core tools and either an extreme paucity or a total absence of typical small tools. Compared with sites in the Ranges, those at Lake Frome are small and sparse. The richest site, Balcoracana Creek, dates to early–mid-Holocene times (Lampert & Hughes in prep.), and it seems probable that the other sites along this shore, with typologically similar tools, had their main phase of occupation during those years.

From the bed of the lake a pollen core obtained by Singh (1981) indicates wetter conditions in early–mid-Holocene times, mainly between 7000 and 4000 BP, a period that coincides not only with that of human occupation there, but also with a moist phase evidenced by several lakes in south-eastern South Australia (Dodson 1974, 1975; Lampert 1981).

A full excavation report on both Balcoracana Creek and Hawker Lagoon (Lampert & Hughes in prep.) is in preparation. Our comments here are a provisional report which can be evaluated further when the final report is available.

4. Hawker Lagoon

This is a small, ephemeral lake less than one kilometre in diameter, located in a narrow synclinal valley in the northern Flinders Ranges. Fed by local run off from a small catchment, the lake has been actually full only three times in the last 40 years, but it is partly full more frequently. According to local residents, when it does fill, water persists there for several months.

Over about 50 ha of the deeply eroded lake-shore lunette and adjoining dunefield, there is an enormous, rich surface site. Scattered profusely are large core tools, flake scrapers, microliths, pirris, tulas and seed grinders. At first glance these might seem to be components of one industry let down on to the eroded surface from a single stratum, but this view is dispelled by closer inspection.

Core tools and some flake scrapers are scattered widely across the entire 50 ha of the site, but most of the small tools and seed grinders are concentrated in much smaller areas near two overflow channels from the lake. More significantly, stone tools can be seen eroding from three superimposed strata in dunes adjacent to the eroded areas. Excavation over several seasons produced core tools and scrapers in the earliest level, dated to c. 15 000 BP, a few small tools in the middle level dated to c. 5000 BP, and a very rich small tool industry in the top level which was laid down in the last few centuries.

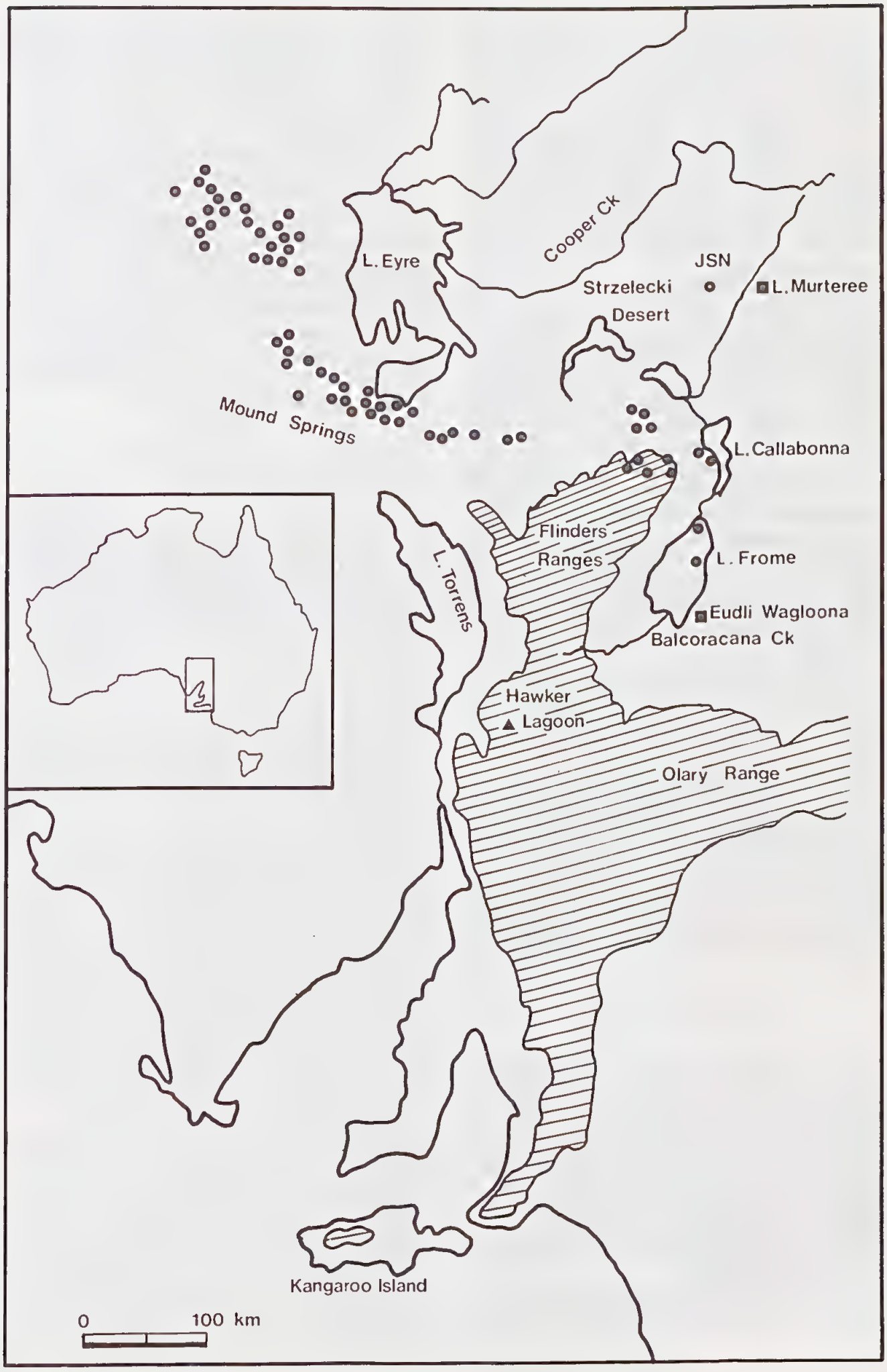

FIGURE 1. Map showing place-names mentioned in the text.

The tools recovered from the lowest level appear identical to those in a larger sample collected from a part of the site's surface where only core tools and scrapers are present. A metrical-statistical comparison (cf. Lampert 1981) of this larger sample with surface collections from the Kangaroo Island region shows the industry to be typically Kartan. At Hawker Lagoon then, Kartan tools were used across the entire area of a large site some 15 000 years ago, whereas small tools and seed grinders were used in more localised areas during the past few thousand years.

Excavations in the lunette at the lake margin revealed, below typical aeolian sediments, a layer of clean white sand that wedges out towards the lake. This we interpret as a beach, indicating a long term stand of high water in the past. Stratigraphically these sands lie between the 15 000 year old Kartan level and the earliest small tool level, some 5000 years old.

Over the rest of the site, these levels meet each other disconformably where beach sands are absent, the weathered surface of the lowest level indicating a phase of erosion between 15 000 BP and small tool times. Because this weathered surface continues below the beach sands, high lake levels must have occurred around the end of the phase of erosion and not long before the first small tools were used at the site.

Almost certainly, the high water levels reflect the same early-mid-Holocene moist phase evidenced, not only at Lake Frome some 160 km to the north-east, but also at lakes in south-eastern South Australia, 500 km and more away.

Also of significance is the absence of any concentration of artefacts as a lag deposit on the eroded surface of the lowest level, and the extreme paucity of artefacts in the middle level that lies immediately above. Thus, human activity was at its sparsest at Hawker Lagoon, not only during the phase of erosion (when we might expect it), but also (and paradoxically) during the phase of high lake levels.

The Regional Picture

However, this seeming paradox can be resolved simply by looking at the regional picture. The shore of Lake Frome was occupied most intensively at this very time, in the early-mid-Holocene, suggesting that moister conditions generally allowed people to extend their activities more broadly across the landscape, reaching places like Lake Frome, which today are inhospitable, and having less need to concentrate on places like Hawker Lagoon where water is more reliable.

Recent Aboriginal land use in the region offers support for this explanation of events that occurred thousands of years ago. John McKenzie, an elder of the local Adnyamathanha people, took Lampert to the eastern shore of Lake Frome, which is even more arid than the western shore already referred to. He indicated a small spring, known to his people as Eudli Wagloona, the only source of water for scores of kilometres. Stories handed down to John by his father say that the 'old people' in his group visited this spring, but only infrequently, when 'seasons were particularly good', spending most of their time in the better-watered Ranges. A sparse scatter of stone flakes around the spring, in an otherwise archaeologically barren landscape, accords with John McKenzie's story of occasional visits. Although the time scale is different, the pattern of movement and the underlying motives, are exactly those deduced from archaeological evidence for the early-mid-Holocene.

Conclusions

Because the Flinders Ranges are better-watered than their surroundings, human occupation there was more intensive and of longer duration, dating back some 15 000 years. Lake Frome, one of the most arid places in the study region, was visited only when wetter conditions prevailed, whether over the long term as in the early-mid-Holocene or occasionally during good seasons as in the recent past. While this movement in recent times was one of environmental opportunism — taking advantage of unusually good conditions to visit a remote site — the fact that this site has a name indicates that such visits were part of a cycle and not isolated incidents.

On present evidence, the Lake Eyre Basin to the north seems to have been first occupied in the late Holocene. We gain a picture of people, based in the Ranges during the late Pleistocene, making occasional forays to the surrounding plains as stressful arid conditions of the last glacial maximum ameliorated. On one of these visits, made some 13 000 years ago, they reached the heart of the Strzelecki Desert (Wasson 1983). During the early-mid-Holocene they made visits of longer duration to the shore of Lake Frome. Possibly they also reached some of the mound springs at this time, but more field research is needed to test this hypothesis.

The evidence viewed so far suggests that people were able to reside in the central arid core of Australia only well after the harsh, desiccating conditions of the last glacial maximum had ameliorated (cf. Bowdler 1977). But was this the initial human occupation of the region? An alternative view is that occupation took place before this, before say 22 000 BP, but the onset of aridity caused depopulation, people perhaps falling back on the

better-watered Ranges. Widespread aeolian movements of sediments at the time of the glacial maximum then obliterated the evidence of their former visits. This seems a reasonably valid alternative given occupation at Lake Mungo under fairly moist conditions more than 30 000 years ago.

Identifying this possible early occupation in the Lake Eyre Basin is the aim of our current research project. We are encouraged in this by the recognition by Wasson (1983) of source bordering dunes and other sedimentary features that denote drainage patterns ancestral to the present system. These predate the linear dunes which form the major part of today's land surface. Whereas our earlier survey largely followed modern drainage systems, we are concentrating now on the early sediments that have been identified.

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LEAVING THE SPINIFEX: THE IMPACT OF RATIONS, MISSIONS, AND THE ATOMIC TESTS ON THE SOUTHERN PITJANTJATJARA

M. BRADY

BRADY, M. 1986. Leaving the spinifex: the impact of rations, missions, and the atomic tests on the southern Pitjantjatjara. *Rec. S. Aust. Mus.* **20**: 35–45.

The paper describes the circumstances whereby Aboriginal people of the Great Victoria Desert came into contact with the United Aborigines' Mission at Ooldea Soak on the Transcontinental Railway line in the early part of this century. The influence of rations is found to be of acute significance to these incoming movements. Rations were utilised by the missionaries, the railway authorities, and later by the Woomera and Maralinga authorities, as a means whereby they might enforce control on the movements of Aborigines in the region. The access by these people to their country was finally blocked in the 1950s when the area north of the railway line was alienated to become the proving ground for atomic weapons by the British Government at sites near Emu and Maralinga. Nevertheless, as the paper shows, the ceremonial life and social organisation of the ex-Ooldea people, who became the Yalata people, has been retained. In this process, earlier inter-group designations have become subsumed under the all-encompassing identity of the Pitjantjatjara.

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The antecedents of the people who now live at Yalata were people with affiliations to the desert and spinifex country in the far north and north-west of South Australia, stretching over into Western Australia. Of central importance to their history is Ooldea Soak, known by Yalata people today as *Yuuldul*, a natural and permanent source of potable water, lying a few feet below the surface on a clay bed. R. and C. Berndt noted in 1942 that Aborigines called the place *'Juldi'gabi* (Ooldea water) (1942a: 323). The place-name may be Wirangu, as the soak lay on their land. The United Aborigines' Mission at Ooldea was, for many desert dwellers, their first stable source of European rations, and the Mission acted as a powerful attraction to Aborigines, drawing them out of the spinifex, and bringing about a cumulative state of entrapment and dependency. In this paper, I examine the circumstances which caused these groups of Western Desert people to leave their country and the means whereby they were prevented from returning to it.

Migrations and Movements

Ooldea Soak lies 6 km north of the Ooldea siding on the Transcontinental Railway line, on the north-eastern edge of the Nullarbor Plain, and on the southern edge of the spinifex, mulga and sandhill ranges which stretch north and west (see Fig. 1, p. 2). Bolam, a railwayman posted to Ooldea from 1918 to 1925, reported that heavy rains north or north-east from Ooldea would benefit the Soak within a week; he hypothesised that there was an underground flow originating in the Musgrave or Everard Ranges (Bolam 1923: 18). He also stated that there were several different wells of water: fresh, brackish and bitter, and that the bitter spring had healing properties known to the Aborigines (1923: 15). The Soak, because of its permanency, was evidently known to Aboriginal people of many different language groups, not only the desert or 'spinifex' people from the north, but the coastal people as far west as Eucla, and east to Fowler's Bay and beyond. In the early part of the century people from the Mann, Musgrave, Everard and MacDonnell ranges in Central Australia, Tarcoola (on the Transcontinental Railway to the east), Kalgoorlie in Western Australia, and coastal groups were known to frequent the Soak (Berndt 1959: 84). The Aboriginal owners of the Soak were probably Wirangu people (R. & C. Berndt 1942a: 323), although it lay within the range of Kokatha people whose territory extended north and east. Tindale placed the Soak as a four-way meeting point for the Kokatha and Ngalea language groups to the north-east and north-west, and the Wirangu and Mirning people to the south-east and south-west (Tindale 1974). Because Ooldea hosted numbers of visiting people from different regions, it was the location of considerable trading exchanges. Wombat-fur twine, ochre, bush tobacco, pearl-shell and pipeclay were traded items mentioned by R. & C. Berndt (1942c: 168). Bolam mentions the trading of 'initiation stones' which were 'small flints with a knife edge . . . carefully preserved in

FIGURE 1. H. E. Green distributing rations at Ooldea in the 1940s. (South Australian Museum Archives.)

wrappings (generally of skin)' (1923: 85). Johnston reported that the quartzite flakes common at Ooldea (still to be seen today in profusion there) were said to come from the *apu* (stoney) country (the Everard Ranges), and some originated from Tertiary deposits near Eucla (Johnston 1941: 40).

Considerable population movement had probably been in process before Europeans arrived in the region (R. & C. Berndt 1942a: 326). In 1941 R. Berndt noted the expansion of the 'culture of the Western Desert peoples' which had 'spread fanwise from the north-west, driving back or incorporating the different elements of the more southern region' (Berndt 1941: 4). The Pitjantjatjara and other north-western groups moved eastwards, and the Yankunytjatjara and Antakirinja moved south. Daisy Bates documents that the people she called the Koogurda were subjected to the pressure of incoming migrations of northern groups. In 1930 Elkin noted a population of two hundred, mostly Kokatha people of mixed European-Aboriginal descent at Koonibba, and some forty Wirangu living in the Iron Knob ration depot area (the top of the Eyre Peninsula) (Elkin 1931: 62-63). It seems likely that the Wirangu and Kokatha were the groups to take the brunt of first sustained contact with Europeans — workers constructing the Transcontinental railway line between 1909 and 1917. Many mixed descent children were born as a result of this contact.

Despite, or even as a result of, these patterns of movement, several researchers have noted the remarkable unity of language and social organisation of Aboriginal groups from as far west as Kalgoorlie and across the area north of the Nullarbor as far as the Northern Territory border (Elkin 1931, Berndt 1959: 44).

R. & C. Berndt, who undertook fieldwork at Ooldea Soak in 1941, noted the presence of Antakirinja people (originally from the Everard Ranges). Pitjandjara, Murunitja, Nangatadjara, [from Western Australia], Mandjindja, and Wirangu' who all spoke Pitjantjatjara, but with localised dialects (Berndt & Johnston 1942: 189-190).

Europeans Find the Soak

The first Europeans to be taken to Ooldea Soak were two well-sinkers who were working at Fowler's Bay in the early 1870s; in 1875 Ernest Giles used Ooldea as the starting-point for his inland crossing of the Nullarbor (Bolam 1927: 11, Johnston 1941: 38). His guide was a Wirangu man called Jimmy (Giles 1880: 6). Leaving Fowler's Bay, the party travelled west to Colona, which was then an 'out station' of the Yalata homestead at Fowler's Bay. From Colona heading north, they passed Ifould Lake, a site known to Yalata people and believed to have been created by *wanampi* (Pitj.) a

mythological snake. Giles's Wirangu guide informed them that it was:

> the footmark (or track) of a monstrous animal or snake that used to haunt the neighbourhood of the big plain, and which had once been driven by the Cockata blacks out of the mountains to the north (the Musgrave Ranges of my last expedition) . . . Another thing was rather strange, and that was how these coast natives should know there were any mountains to the north of them . . . (Giles 1880: 6; see also R. Berndt 1941: 17).

The party also passed Pidinga and camped at the rockholes there. Giles traversed the last thirty-three miles to Ooldea, where they found a 'shallow native well in the sandy ground of a small hollow' (Giles 1880: 7). The party slabbed up the sand at the Soak to obtain access to water for men, horses and camels. Giles' impression of the Soak was initially marred by the intense heat and he described it as a 'fearful place' (Giles 1880: 10). He does not report evidence of Aboriginal visitation in the region of the Soak.

Some years later other Europeans recognised the potential for the Soak's water supply: in 1897 the South Australian Government Geologist H. Y. L. Brown noted that it was the only permanent and reliable water source in the region, and in 1901 the Soak was earmarked to supply water during the construction of the railway. R.T. Maurice, reconnoitering the possible exploitation of resources in the region in 1901 suggested that although the land had little value from a pastoral point of view it 'surely must contain some minerals or metals of value' (Murray 1901: 39). The Transcontinental Railway construction teams commenced work from each end, and the tracks from east and west came together at a point between the sidings of Ooldea and Watson. Construction took five years and the line was completed in 1917. The Soak was bored for water and up to 70 000 gallons (320 000 litres) per week were drawn from it (Berkery 1944: 33); a pumper was stationed there to supervise the water supply, and a siding was built a few kilometres south of it. Construction and maintenance workers lived in camps along the line, and a growing number of Aboriginal people, attracted by the activity, camped in the vicinity so that when Mrs Daisy Bates arrived at Ooldea in 1919, hundreds of Aborigines were in contact with Europeans.

Daisy Bates: Telling of Their Being and Their Ending

Mrs Bates had travelled to Australia in 1899 in order to investigate allegations of cruelty to Aborigines for a London newspaper (White 1985a: 5). After considerable periods of time spent among Western Australian Aborigines, she wrote to the Railways Commissioner: 'I am desirous of resuming work among the sick natives in South Australia and . . . I think the Ooldea area offers a good field for my labours' (Bates 1919). She requested unused huts for her use and for access to a water supply, and justified her presence to the South Australian government and the railway authorities in terms of her caring role for natives. In addition, she argued that the presence of a European woman acted as a deterrent to the 'moral degradation' that ensued from contact between Aboriginal women and railway workers. Using an adroit piece of reasoning, she suggested that a mission at the siding would *promote* prostitution:

> I would not advise any concessions to any aboriginal 'mission' on the line. It would merely be a 'jumping off' place for prostitution . . . In the first place it is a risk to let the natives enter a white person's house . . . the native children have infectious sores that the white children at the Siding have caught more than once . . . (Bates 1924).

It is more likely that Mrs Bates was concerned that a mission would usurp her role at the Soak. In fact she had the field to herself for another nine years before the United Aborigines' Mission (UAM) became established at Ooldea in 1933. For the extent of her stay, Mrs Bates received little official assistance. She gave out small amounts of tea and other foodstuffs from her own supplies, and administered simple medical aid to those who came to her. 'My methods were my own, grandmotherly cough mixtures, massaging with oil, nourishing foods and much cheeriness' she wrote in one of her chapters on Ooldea in 'The Passing of the Aborigines' (1938: 173). Her many courteous letters requesting assistance from the Railways Commissioner, the Protector of Aborigines, and even the Prime Minister, brought little result. For the duration of her sixteen years there, she lived between the Soak and the railway line in a tent. Her correspondence reveals that she endured considerable privations.

Bates documented the mythology of the region (including that for Ooldea Soak), details of daily life, social organisation, language, and often noted when large groups of Aboriginal visitors arrived. For example she described a group of twenty-six men, women and children who arrived from the Mann Ranges, sixteen hundred kilometres to the north-west (1938: 172). She noted that journeys from the northern ranges often took two years, 'zigzagging in the desert for food and water' (1938: 191), that people drank from water-bearing tree roots, and that once encamped along the line they utilised the trains *en masse* as transport to attend ceremonies (1938: 191, 195). Trains provided the

Aborigines living along the line with a fast collective means of transport. The Commonwealth Railways fought a losing battle in their attempts to deter Aborigines from travelling in open cattle trucks, free of charge on most occasions, or on the 'Tea and Sugar' train which called at all the sidings along the line with provisions for railway employees. The railway authorities disliked the impression given by a motley group of Aborigines, and the Commissioner of Railways described the people as 'the poorest type in Australia . . . it would be better if tourists did not see them' (Adelaide *Argus*, 4 April 1934). Even Mrs Bates, who was aware of the advantages to the ceremonial life provided by railway transport, wrote to the Railways Commissioner:

> I have had so much trouble over the visits of these Kalgoorlie mobs that I would ask you to take drastic action to prevent the conveyance to and fro of any and all natives. The so-called Kalgoorlie mobs — dregs of the once numerous Border ranges mobs — are the most undesirable of all natives . . . (Bates, Correspondence, 29 May 1923).

The 'Kalgoorlie mobs' were the kin and ceremonial associates of the spinifex people at Ooldea, and their visits east on the trains (and visits west by Ooldea people) were and still are, part of a network of ceremonial exchanges linking Western Desert people in central areas of Western Australia, across the Nullarbor and north into Central Australia (Tonkinson 1974: 94–98).

The United Aborigines' Mission: Regular Rations

In 1933 the UAM sent Miss Annie Lock to establish a mission at Ooldea Soak, and within two months of her arrival the office of the Chief Protector began to issue her with rations and medicines for distribution:

> I have suggested to the UAM that they should consider opening a small store at Miss Lock's camp where the natives could purchase food and other necessary articles (Correspondence, Chief Protector to Railways Commissioner, October 1933).

Koonibba missionaries who had dealings with both Lock and Bates, report that — not surprisingly — relations between the two were strained (Hans Gaden pers. comm.). Two years after Miss Lock's arrival Mrs Bates left Ooldea.

It is clear from correspondence between the Railways Commissioner and the Protector that the withholding (and conversely, the provision) of rations was utilised as a means whereby these authorities might control the movement and presence of Aborigines along the line. It had been a deliberate policy by the Protector's office not to provide rations for Aborigines at sidings, in an attempt to discourage them from gathering at wayside stations. However, a system of bartering developed between Aborigines and passengers on the trains, whereby artefacts were exchanged for goods and cash. The Protector believed this to be 'detrimental to the aboriginals themselves inasmuch as it encourages them to shiftless habits' (Correspondence, 24 July 1930). With the construction of the railway having itself acted as an attraction for Aboriginal people, and the siding built only a few kilometres from a significant location, the authorities found themselves in an untenable situation, and experiencing an increasingly bad press. They resorted to forcible removal, collaborating with the police to transport Aborigines away from sidings, and urged the Protector to consider relocating the people some distance from the line. The arrival of the UAM was perceived as a last attempt to keep Aborigines from frequenting the line. The provision of rations by Miss Lock, therefore, was a considered technique to persuade the Aborigines to stay in the Soak area and not stray to the line. She reportedly encouraged 'the able-bodied to hunt for wild dogs, foxes and rabbits and intends trading the skins and scalps so as to provide them with money to maintain themselves' (Correspondence between Chief Protector and Commonwealth Railways, 31 October 1933). In addition, she cooked damper for her charges, and evidently 'fed' people rather than just distributing 'raw rations'. At this time (November 1933) there were seventy adults and thirty children at Ooldea. Some of the groups coming into Ooldea had already tried European food, as a result of encounters with doggers and other itinerant whites (cf. White 1985b: 217). Those who arrived a few years later would have received rations from Ernabella, the Presbyterian mission in the north-west of South Australia, which was established in 1937. Dingo scalps were legal tender, being traded in exchange for money and goods, tea, flour and sugar at Ernabella store (Hilliard 1968: 81). Aboriginal reports of this period (from older Yalata people) are remarkable in that they emphasise the considerable traffic in and out of Ooldea (rather than the formation of a stable population), and the deliberate dissemination by Aborigines, of information about the availability of food at Ooldea. Although later missionaries of the UAM sent 'mission' Aborigines short distances out with tobacco and clothing (cf. Turner 1950: 114), this was only once incoming groups were within sight of Ooldea. There is no evidence that those who decided to walk into Ooldea from outlying locations in the spinifex, did so other than voluntarily. However, introduced animals had penetrated as far as the spinifex country and were devastating native fauna; there were rabbits in the Musgrave Ranges

by the turn of the century (Hilliard 1968: 79). There was also drought, recorded for example by Dr Charles Duguid in 1939 west of the Mann Ranges. People remember Mrs Bates ('Mrs Biddy') and Annie Lock ('Miss Locks'), and the food. Yalata people who remember these years reported:

> We heard about meat, sheep and good tucker at Ooldea and so we went [to] Cook and jump on the train to Ooldea . . . went back out spinifex and brought in my wife and her mob. (TQ)

> We never travel in the hot times. We went back out with that yarn about tucker and spread the word . . . we came in again and went back out . . . (KQ)

> My husband and my sister L.S. came in. She was a child, not a woman. My sister told me 'lot of flour at Ooldea' . . . we all met up and came in [lists rockholes *en route*] Mrs Bates was there . . . she gave me dress 'cos I came long way from Iltur [Coffin Hill]. (RS)

Yalata people also recall carrying rations back out to the spinifex so that others could 'taste' them. One elderly man carried rations from Ooldea to 'echo place' (probably Echo Hill, north of the Everard Ranges); despite eating a portion of them *en route*, he was able to distribute half a bag of flour, together with tea and sugar.

Although people have described that they walked in and out of Ooldea on several occasions at intervals of months, or even years, after several such trips, many people made Ooldea a semi-permanent base:

> We sat down there with Miss Lock and Miss Tyler and Mr Simmonds. I didn't go back spinifex but went to Makuru [rockhole north of Cook]. (RS)

> No-one said '*wanti*' [leave it i.e. Ooldea] we are going to stay here' [i.e. spinifex]. (SY)

The mission had expanded over the years, and a boys' and girls' 'home' (dormitory) constructed (cf. Turner 1950). Aboriginal parents were encouraged to place their children in the homes where they were subjected to a vigorous regime of Christian indoctrination, physical drill, boys' brigade and daily prayers. Rations for the camp dwellers were distributed after morning service, and R. & C. Berndt (who wrote critically of the practices of the UAM) observed:

> The natives have heard much about God and Christ, but their conception of them is confused so that they have in part become identified with the distribution of rations . . . the church is an interesting and diverting social occasion (Berndt 1942b: 56).

There is no doubt that European rations were strongly desired and the Berndts remarked on the 'great reliance' placed by Aborigines on their Government rations (1942b: 59) (see Fig. 1). Undoubtedly the explanation for the extraordinary movement towards a stable source of foodstuffs lies, in part, in the hardships and difficulty of the food quest, as opposed to the consistency and volume of rations distributed. As Hamilton suggested, 'put in ecological terms, it was a question of maintaining an energy input/output balance favourable to human survival' (1972: 41). Seed-grinding by women was probably one of the most arduous tasks, and Yalata women told me that grinding seeds with *tjungari* (top stone) and making *nyuma* (seed cake) 'finish altogether, finish at Ooldea, finish — flour!' A dental researcher who visited Ooldea in 1926 (before full-scale ration distribution had commenced) noted 'a fair amount' of attrition to adults' teeth from the 'vigorous use of teeth and roughness of food'. However, he also observed even then that Aborigines at Ooldea ate 'white bread and cake when obtainable, and use white flour, while their craving for free sugar is marked'. He described this diet as 'pappy' (Campbell & Lewis 1926: 375).

Anderson (1983) has argued against an overly simplistic 'ecological imperative' explanation for Aboriginal people moving towards European food sources, suggesting that food, goods and services were obtained in the context of a social relationship with *particular*, permanent whites. This facilitated the development of a 'proper' relationship between Aborigines and Europeans, from an Aboriginal point of view (1983: 489). This special social relationship with individual whites was certainly developed with Mrs Bates and with Harrie Green of the UAM. The presence of these particular Europeans is used as time-markers by older Yalata people now, so that people describe a period as 'Mis' Bates' time' or 'Mr Green time'.

Hamilton discusses the reciprocal nature of the relationship between Aborigines and Europeans suggesting that the distribution of rations by Europeans was an act bearing reciprocal connotations of which most Europeans were largely unaware. The Aborigines who walked in to Ooldea, and more specifically, those who stayed, had discovered an apparently unfailing source of food which the UAM missionaries were willing to distribute with virtually no strings attached — apart from attendance at Christian service already mentioned. A few Europeans, including Daisy Bates, were not only aware of the reciprocal exchanges expected by Aborigines, but endeavoured to engage in such exchanges; they made *use* of them. For example, because Bates' circumstances were so straightened, she often went without sufficient food herself: 'when times were lean, and the natives had only a small damper, they could be sure that I had an even smaller piece of toast' (Bates 1938: 194).

She accepted offers of bush food on such occasions: 'I made a meal of an iguana that two friends . . . caught and cooked for me' (1938: 170), and was provided with other gifts of food, 'One day Gindigi misunderstood me, thought I was hungry, and brought me a billy-can of broken bread he had begged from the train-passengers' (1938: 194). Another European graced with some understanding of Aboriginal practices, Woomera Native Patrol Officer Walter MacDougall, wrote of reciprocal exchanges:

> When contacts are first made the aborigine likes to give presents in appreciation of gifts he may receive. It is perhaps natural that the white refuses the gift of some half-cooked kangaroo or mangey-looking rabbit (even though he is not obliged to eat it) but the result is that very quickly the aborigine believes that the white will provide free and continuing food from his inexhaustable supply for nothing in return . . . (MacDougall 1956).

R. & C. Berndt commented that the Ooldea Aborigines thought 'the rations are less than they should be and that the government . . . is bound to support them' (1942b: 59). Catherine Berndt wrote that although she wore almost the same clothes every day, the women demanded that she give them what she wore: 'you plenty blouse, me nothing' (R. & C. Berndt 1944a: 220). For at least some years, the UAM *sold* the rations (half a bag of flour was ten shillings, a double handful of sugar four shillings). On one occasion, a local police sergeant passed on the complaint from an Aboriginal man that although the Mission received the rations free of charge, they made the Aborigines pay for them. This undoubtedly contributed to Aboriginal resentment against the whites, who were perceived to have a plenitude of supplies. R. &. C. Berndt report hearing a narrative which supports this view:

> One such descriptive story, told by a young man, narrates a hunting exploit and tells of cooking and distributing the meat among relatives and friends, certain parts being given to the hunter's dogs. After describing various incidents, the narrative ends with a harangue against the white man, a distributor of rations, who although having much food refused to give any to the teller of the story (R. & C. Berndt 1942c: 161).

In other words, the distributor of rations (or any other desired object) was compared with the individual who, being the possessor of meat, gives it to his relatives. Merely to be in possession of an object desired by another, then, entails the requirement that it be given, unless the possessor can improvise a strategy whereby he might avoid such a demand. It is clear that although the European view may have been that Aborigines were more demanding than they 'should' have been, from the Aboriginal perspective, Europeans never came up with an acceptable reason why they should not acquiesce to Aboriginal demands.

By the mid-1940s, those who had 'sat down' in the vicinity of the mission were 'hooked' — in a sense, psychologically addicted to European food, caught up in a particular rhythm of life, and involved in a new social relationship. One Yalata man, who was born not in the spinifex but at Kingoonya (on the railway line) explained why he stayed on at Ooldea:

> My father (JW) went back bush and came back later on. He took boys out spinifex. I grew up on the flour and sugar and got hungry for that. Old people didn't know it, Because I grew up on that I stayed around. I never tried to run away. I was in the *mayi* [vegetable food, i.e. white man's food] too long. (HW)

Although many groups still lived in the spinifex, the population at Ooldea grew; in 1941 R. & C. Berndt reported two hundred people there, most of whom walked back into the spinifex after good rains. Eleven years later, at the closure of the mission, the population was around three hundred. At ceremonies between four and five hundred people gathered at Ooldea (R. & C. Berndt 1942a: 312).

Although there is no doubt that these southern spinifex people initially left their country voluntarily (or at least free of overt persuasion by Europeans) there can also be no doubt that they had no intimation that a later return would not be possible, and certainly it was inconceivable that they could 'lose' the country. Yalata people made it clear that it was kin who drew others in to Ooldea: husbands went back to the spinifex to bring in wives; daughters brought in their mothers. People were determinedly keeping their families together. Additionally, once senior people with responsibility for particular places had gone to Ooldea, others felt uneasy at those sites without them. Whether this was so for a large number of sites I was unable to discover. It may have been the case only for sites which were believed to be mildly dangerous, as in the following instance. The story concerns the location Wantunya, a well which lies north of Cook and south-west of Wyola Lakes. The site is associated with the mythological snake who is believed to live submerged in the well. Other snakes (throughout the desert) are believed to be highly dangerous and their *ngura* (camps) are avoided: this one is known to be 'quiet'. The account which follows was provided by a Yalata woman, recalling the time when she travelled into Ooldea:

> *Wanampi* [snake] go right through underground, when hungry, he ask for meat, food, he ask — like thunder he make noise — he like rabbit. Everybody, *anangu* put rabbit there for him all around, leave them whole and

> he can have them. He come out at night after you go away. Then he [snake] give them [people] water . . . My mother and me, we camp here. After that, Ooldea, came back, then, never came back. When A. [woman's name] and eldest daughter went to Ooldea, we got frightened — boss *muka* all gone to Ooldea, [lists names] . . . because they went, boss, we can't come. Then *wanampi* lonely, he get wild, *wanampi* get wild. He get sulky if no meat [is given to him]. Stranger *muka* they won't give a feed [to him] and he won't give them water. (AC)

The narrator thus explains her unwillingness to stay at Wantunya for two reasons: the absence of those she calls 'bosses' for the place, and the influence of this absence on the potentially dangerous snake. The story is also interesting in its attention to the correct procedures of exchange. The strangers (possibly white men) are unaware of the requirement to feed rabbits to the snake, and in return the snake will not make water available to them.

The UAM: Spiritual Assault and Spiritual Resistance

The UAM missionaries wavered between despair at having more mouths to feed, and elation at the prospect of having more souls to save, on the occasions when large contingents arrived for ceremonial purposes. The UAM believed that they were making headway in the spiritual battle. Harrie Green, in correspondence with me before he died in 1979 wrote:

> . . . native customs gradually ceased as the people became desirous of a civilised way of life . . . there seemed to be little clash of cultures . . . we taught them our Christian ways and left them to choose or decide for themselves.

The Berndts however, wrote that Aborigines were:

> subjected to more or less constant pressure to renounce all their primary aboriginal associations and become 'Christians' after the emotionally evangelical style favoured by this sect. (R. & C. Berndt 1951: 134).

The Mission regime was harsh with respect to Aboriginal children in their care. Those who used swear words or who attempted to run away from their dormitories (as many did) were punished by being made to wear dresses of flour bags, or had their heads shaved.

The specific practices utilised by the missionaries are documented in the UAM's journal *The Messenger* . Visits were made to the 'native camp' three kilometres from the Mission itself, in order to preach, and missionaries zealously intervened in traditional mortuary practices in attempts to persuade the ceremonial parties that the deceased should be buried as a Christian. The camps were depicted as a region of sinister and Satanic influences, and the old men were perceived to be particularly evil for they 'compelled' the young to learn 'vile heathen practices'. For this reason, the missionaries focused much attention on the initiation of boys. Mr Green gained access to the secret boards normally accessible only to mature and initiated men. He photographed them and deliberately showed the photographs to young boys (R. & C. Berndt 1951: 137, cf. Young 1951). The Berndts observed that the UAM made no attempt to 'fuse the old with the new', and that the schooling meted out to Aboriginal children ignored Aboriginal culture altogether (1942b: 57).

Despite this assault on Aboriginal belief systems, ceremonies continued to be performed undisturbed (R. & C. Berndt 1942b: 56). Indeed, the Berndts' voluminous ethnography of Ooldea provides compelling evidence of the ability of the Ooldea Aborigines to withstand the missionaries' message. Despite the fact that large numbers of desert people remained at Ooldea during the 1940s, R. & C. Berndt discovered that there was no loss of knowledge of rockhole and other water sources (1942b: 68), and that the mythology and ceremonial enactments of the Ooldea people revealed both adaptation and resilience. Stressing the fluidity and flexibility of Aboriginal religious life, the Berndts wrote:

> They have the right to interpret for themselves their mythological dogma and blend it with the changing conditions of life. When they are detribalized, a myth may be extended; alien myths incorporated; new sites sacralised and modifications in certain rites because of white contact, obtained. But its structure and original intent is unaltered (R. & C. Berndt 1942a: 329).

Precisely this process occurred among the in-migrations of people from the desert and *apu* (stoney) country north and north-west of Ooldea — the intervening regions are now firmly incorporated into the country of those now living at Yalata, and their kin in the north. Even the country south of the railway line, previously Wirangu country, was incorporated, according to R. & C. Berndt (1942b: 65).

Informants living at Yalata today say that by the late 1940s all their known relatives had 'come in' from the spinifex, although the patrol reports compiled by Native Patrol Officers MacDougall and McAuley show that small groups of Western Desert people were still there throughout the late 1950s and early 1960s — for the duration of the atomic tests at Emu and Maralinga. After the Ooldea Mission closed down in 1952, Aborigines who were unaware of its closure made sporadic visits from the north.

Visits of this nature are documented for 1953, 1954 and 1955. Finding the Mission closed, they simply walked back out again. In 1957 a party of four people (an elderly man, his wife and two children) who had set off approximately twelve months earlier to walk to Ooldea from Ernabella were discovered by military personnel camped within a contaminated area near the Marcoo test site. (McClelland *et al.* 1985: 319–323). Survivors of the family who now live at Yalata, report that they were walking down 'for rations' and that they did not know the mission had closed five years previously. Some groups were taken into Cundeelee W.A., as late as 1963, and it was established that they too, had traversed the Maralinga prohibited zones during the years of the atomic testing programme (*ibid.*: 368). There is, then, evidence that the spinifex was not entirely depopulated in the regions north and north-west of Ooldea, until the early 1960s.

The Demise of the Mission

There is no doubt that conditions at Ooldea were primitive and uncomfortable for the missionaries, and became increasingly difficult for the Aborigines camped there. As far back as 1938 there had been plans to move the Mission — at that stage, to Pidinga; then in 1941 Lake Phillipson, near Coober Pedy, was proposed. In 1948 the UAM *Messenger* told of the possibility of the Mission moving to the siding a short distance away. In 1949 the Aborigines' Protection Board Annual Report declared that Ooldea was unsuitable as a Mission site, and a new site was promised. There were additional pressures for a move, though, which were unknown to the missionaries. Walter MacDougall, employed by the Long Range Weapons Establishment at Woomera, was becoming concerned that the presence of Ooldea as a rations centre was continuing to promote movement by Aborigines between the centres of population in the north-east, and the railway line. This meant that they placed themselves in the vicinity of the Woomera Range. When the Aborigines' Protection Board noted in their Annual Report of 1950 that a pastoral property to the south was under consideration as a new location for the Ooldea people, he strenuously supported the proposal.

The negotiations for the new Yalata property on the west coast were protracted, and complicated by the rivalry that emerged between the Lutheran Church and the UAM over which denomination would control the new establishment. The Lutherans were opposed to another denomination becoming established in an area where they held sway (they had a mission at Koonibba, east of the new station). The leasehold property was purchased by the South Australian Government in 1951 (Hampel 1977: 6). However, an internal dispute split the UAM: the South Australian branch formed a breakaway mission, and staff were forced to declare their loyalties. The Greens and others at Ooldea decided to remain allied with the Federal body, in Melbourne. At the last minute, five days before the Ooldea missionaries were to leave, the South Australian branch announced that it had insufficient missionaries to take over the Ooldea people — and so it eventuated that the Lutherans were asked at short notice to intercede. It all happened very suddenly, as the Aborigines there recall:

> When Ooldea finished, too sudden. People were all mixed up, don't know where to go that time. People were very sad when Mission finished . . . crying. (HW)

> Sad day, *mayi wiyaringu* [food became finished] when Ooldea closed. (TQ)

On 24 June 1952 amid some confusion, the UAM missionaries left by train, and Lutherans from Koonibba arrived to transport people south to the new, and as yet undeveloped, property. The children were to be placed in the Koonibba school as an interim measure, for the Aborigines Protection Board had expressed concern should the home children 'fall into the hands of the camp natives' (Hampel 1977: 7). The 'camp natives' were, of course, the parents and kin of the children. Initially, the Aborigines were given the choice as to which way they could go:

> Mr Green tried to draft us out, which way we wanted to go. We didn't want to go bush way, too hard. (KQ)

> South mob, west mob, all the groups were ready to go each way. I went with Tarcoola mob and by truck up to Bulgunnia. We stopped there for one week, then they sent two trucks up [to get us]. We never said nothing. We wanted to go north really, but thinking of rations. (SY)

> *Anangu ngurpa* [Aborigines were ignorant; i.e. did not know what was happening]. (SM)

Isobel White collected accounts of the move in which the women could not recall being given a choice of destination (pers. comm.). The variety of views highlighted the confusion of the whole experience. The Lutherans succeeded in taking only sixty-seven people down to Colona on the Yalata property, and these were all Kokatha people (Hans Gaden pers. comm., Hampel 1977: 8). The Cundeelee mob opted to wait for the next train going west; and the north group decided to join kin at Ernabella. As described above (and also by White 1985b: 222), they set off on this journey, disembarking from the train at Tarcoola and reaching

Bulgunnia Station (already known to some of the men). Here Walter MacDougall turned them back, and arranged for their transport back to Ooldea and thence to Colona on the Yalata property. MacDougall had in fact stumbled upon the closure of the Mission as he undertook a patrol along the line. MacDougall's subsequent Patrol Report reveals that he was unaware that the UAM were pulling out:

> From conversation [with Aborigines at 416 camp, east of Ooldea] I gathered that the movement of all aborigines from Ooldea to Yalata was imminent. I also gathered that the people concerned did not clearly understand what was to happen. They were under the impression that they were to return to the area in which they were born . . . On arrival at Ooldea the next day I found that in fact preparations for the move to Yalata had commenced (MacDougall 1952).

He described the scene as a 'muddle'. Having allowed the north-bound group to leave, he then chased after them by road, evidently having thought better of it. His report states 'I decided to take charge of those who had gone to Tarcoola'. It is tempting to assume that MacDougall had specific knowledge at that time of the impending decision to test atomic weapons somewhere north of the railway line. There is, however, only indirect evidence that MacDougall had been alerted to this development. His patrol along the East-West Line which was interrupted by the Ooldea move was in order to check the area as far west as Cook for a possible extension of (what was euphemistically called) 'range activity'. His Patrol Report leaves no doubt but that his task was to keep Aborigines well away from the range, and that his decision to intercept the north-bound group was a part of this task:

> All Ooldea Aborigines who originally came from the north and who would, therefore, be likely to periodically occupy areas required *or likely to be required* by LRWE range as far west as Cook, have now been transported to Colona on their way to the new depot at Yalata . . . Tribal natives from the Central Reserve will not be so likely to travel south when they know that there is now no ration depot at Ooldea (MacDougall 1952, emphasis added).

It is hard to imagine that he had not considered that the desert area west of Woomera was an obvious choice for an atomic testing site. The public announcement that there were to be atomic tests *somewhere* in Australia had already been made four months earlier, in February 1952. Dr Charles Duguid, among others, had long surmised that the Woomera region was a likely location (Duguid 1947: 14). Whatever his true reasons, MacDougall persuaded a large group (he counted one hundred and five people) to abandon their planned journey north, and to travel south, to Yalata station, to new country. Once MacDougall reported that the move had been finalised, his employers at Woomera were extremely pleased; his performance was deemed 'highly satisfactory'. Exactly a year later on 24 June 1953 it was publicly announced that atomic weapons were to be tested in the long-range weapons area. In October 1953, after the first test (Totem 1) had occurred at Emu Field, another location was discovered which was to be a permanent proving ground. This was at a site which came to be named Maralinga, 53 km north of Ooldea, directly in line with the Aboriginal routes which followed rockholes north. It was just as well the Mission had moved.

Blocking off the Country

The fact that the area earmarked for atomic tests encroached on an Aboriginal Reserve (proclaimed at Ooldea in 1936) was of little import. Moves were made for its immediate revocation. It was described as 'abandoned'. MacDougall visited the Soak and several sites of significance with ex-Ooldea men in 1954; he intended to 'clean up' the area by removing ritual paraphernalia hidden there (MacDougall 1954). He was then able to report to his superiors that 'all active tribal interest is now at an end'. The Ooldea Reserve was abolished on 9 December 1954.

Looking back on this period, Yalata people believe that MacDougall 'blocked' them from their country. They were right. Aborigines were discouraged from walking north even to the railway line, unless it was for an approved purpose. Military personnel were stationed at Watson siding (the supply point to the Maralinga village), and the Lutheran missionaries reported planned Aboriginal movements to the Maralinga authorities. In 1955 a large group of Yalata people were gathered in the Coober Pedy area after ceremonies (probably Kurangura). MacDougall found them there and decided to:

> . . . cut out all rations and start[ed] them on their way. I arranged for most of the women to travel in passing trucks . . . thus ensuring that their men would not attempt to travel overland via Lake Phillopson [*sic*] Panthanna and Tietkins Well (MacDougall 1955).

An initiation party of Yalata people headed for Cundeelee was intercepted at Ooldea in September 1956, by security officials from Maralinga. The novice and two other Aborigines were allowed to travel by train to Zanthus, Western Australia, while the rest of the party, numbering one hundred and twenty people, was instructed to wait until permission was granted for them to travel west. This was exected to take two months (Lawrence 1956).

Notwithstanding this extraordinary history of competing interests whereby the Ooldea people suffered the effects of a series of invasive and exploitative actions on the part of Europeans, they

tenaciously maintained crucial elements of social organisation and their ritual responsibilities to kinsmen and kinswomen elsewhere. Visits to other communities, and the reception of visitors from elsewhere, were maintained over the early years of their relocation to Yalata, and are still in place today. There is documentation of visits to Coober Pedy, and to Cundeelee, in 1954, 1955 and 1956 in order to attend ceremonies. In 1956 two hundred people from Yalata planned to travel west by train, and then walk to Warburton; Yalata hosted ceremonial parties from the north and west (see McClelland *et al.* 1985: 301–302.

Identity and Ethnicity

Yalata people, with only a few exceptions, now describe themselves as being Pitjantjatjara. The exceptions are those who identify themselves as Yankunytjatjara. As with their kin in the north, they now use the term *anangu* to describe themselves, as opposed to *piranpa* [whites].

In view of the fact that their predecessors at Ooldea Soak were drawn from many different groups, it is remarkable that Yalata people now identify *en bloc* as being Pitjantjatjara. When R. & C. Berndt worked at Ooldea Soak in 1941 they noted the variety of different groups, of whom the Pitjantjatjara were but one. In fact, they observed that the Antakarinja, originally from the Everard Ranges, formed the greater part of the camp population. These were described as people who had travelled south, and in the 1940s 'wandered' in the country north of Ooldea (Berndt 1941: 1). White noted in 1977 that the designation 'Andagarinja' or 'Antingari' seemed to have disappeared at Yalata, and hypothesised that the group may have moved elsewhere when Ooldea closed down in 1952 (White 1977: 105). However, reports from Aborigines present at the time of dispersal state that there were three groups: the west (Cundeelee) group; the south group (sixty-seven Kokatha people), and the north group (the 'Pitjantjatjara', who departed for Tarcoola).

It is likely that in recent years the designation Antakarinja has become blurred into the group with the greatest currency, the Pitjantjatjara. Distinctions between groups were not always made, even in the 1940s. Berndt gives an example of an Antakirinja man who 'might at times identify himself as Bidjandjara' (Berndt 1959: 90). It is likely that inter-group dialect affiliations have gradually been relinquished as a result of the social environment and shared experiences of the ex-Ooldea people. This process had begun at Ooldea by the time of the Berndts' fieldwork, and they observed intense contact between different dialect groups which led to 'fluidity and carelessness' of speech (R. & C. Berndt 1944b: 49). The people have been together, in various permutations, for fifty years. Nevertheless, the present-day 'community' is rarely communal, and is in fact composed of numerous autonomous family or hearth groups.

In more recent years, the incorporation of the Western Desert Aborigines of South Australia into groupings with some political leverage, as well as their recognition by European law, has meant that 'the Pitjantjatjara' have become an entity over and above the original designation of those who spoke a particular dialect or identified with a particular area of land. Yalata people became politicised during the negotiations for freehold title to the 'Maralinga Lands' (now legislated under the *Maralinga Tjarutja Land Rights Act 1984*, and had watched the earlier developments in the north culminating in the *Pitjantjatjara Land Rights Act 1981*. As a result of these developments, as well as those factors already mentioned, the ex-Ooldea people living at Yalata, and at their outstation established on the Maralinga lands, now understand themselves to be a part of the larger collectivity, 'the Pitjantjatjara'.

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COMING AND GOING: ABORIGINAL MOBILITY IN NORTH-WEST SOUTH AUSTRALIA, 1970–71

A. HAMILTON

HAMILTON, A. 1987. Coming and going: Aboriginal mobility in north-west South Australia, 1970–71. *Rec. S. Aust. Mus.* **20**: 47–57.

This paper has examined a body of data on population mobility in an isolated region of northern South Australia to show that mobility was embedded in the social and economic adjustments essential to Aboriginal society at that time. Rather than seeing these patterns as an example of cultural continuity, I have suggested that they can best be understood as adjustments to the conditions provided on the frontiers of European settlement, whereby the maintenance of social relationships and access to a network of significant resources provided the basis for economic and cultural survival.

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To early European observers the most remarkable aspect of Aboriginal life was the absence of agriculture, and the consequences which flowed from that, particularly nomadism. The white Australian consciousness has elaborated on this theme, particularly in the popular concept of 'walkabout' as an innate Aboriginal characteristic, used particularly to explain Aboriginal behaviour which fails to conform to non-Aboriginal expectations about work patterns and predictability of residence. Attempts to integrate Aboriginal people into non-Aboriginal Australian society have been informed by a set of expectations which link together stability of residence, 'civilization', productive labour, and a life-style focused on the maintenance of a certain kind of domestic environment.

The difficulties of achieving this aim were noted by Barron Field in 1825. He remarked:

> We have now lived among [the Aborigines] for more than thirty years; and the most persevering attempts have always been made, ... to induce them to settle, and avail themselves of the arts of life; but they cannot be fixed, nor is it possible by any kindness or cherishing to attach them (Field 1825: 244).

Various explanations were offered for this. The poet Richard Howitt attributed it to the lack of suitable crops:

> Had they been in a more civilised state it would have been singular; for no country on the face of the earth... has been so destitute of the means of fixed residence, corn and fruits, for the localisation of a people. It is easy to call a native a fool for not providing himself with a house, but it is not so easy to furnish him with a fixed maintenance (Howitt 1845: 197).

However, even where a 'fixed maintenance' in the form of paid labour or rations was provided, the propensity of Aboriginal people to move from place to place was not diminished. A simple economic explanation was inadequate. Not suprisingly, as scientific racism grew throughout the nineteenth and early twentieth centuries, Aboriginal mobility was attributed to uncontrollable impulses preventing them from being 'settled'; this in turn implied that they were not able to live within 'normal' Australian society and provided a justification for the various policies of segregation and 'protection' which were devised by successive administrations.

In spite of the historical and political importance which has been attached to mobility, singularly little attention has been paid to understanding the nature of and reasons for patterns of movement in contemporary Aboriginal populations. It has been assumed that, with the demise of 'nomadism' in the pre-colonial form, Aborigines are now 'settled', or should be. Being 'unsettled' contains a host of negative implications in European symbolic systems: homelessness, rootlessness, vagrancy (which derives from Old French, 'to wander') all are marks of inadequacy and failure in life.

Nevertheless, Aborigines in some areas at least attach positive value to mobility, and strive to maximise their access to transport and locations between which frequent unhindered movement can take place. The present paper examines data on patterns of mobility in a remote cattle-station community in 1970–1971, and discusses some of the social and economic factors associated with it.

Studies of mobility among other previously 'hunting and gathering' peoples show that the Aboriginal commitment to mobility is far from unique, and that technological changes which contribute to freedom of movement are enthusiastically taken up. Many peoples who had lived primarily as hunters and gatherers up until quite recent times adopted herding as an economic

strategy under changes brought about by external factors, thus 'building in' mobility to their economic adjustments. More recent changes, largely connected with the availability of motorised transport, have further embedded mobility as a social and cultural value, while sometimes bringing about significant and negative economic consequences.

Pelto's study of the Skolt Lapps of Finland describes the way in which the snowmobile entered the life of the Lapps in the 1960s, displacing items such as reindeer-sleds and skis, and totally transforming the economic base as well as systems of prestige. Transportation of supplies, firewood and people had always been a major adaptational challenge in the Arctic; and the snowmobile offered what seemed to be a miraculous solution. However, the care and maintenance of vehicles created problems, and the reliance on imported fuels had profound effects on economic choices. Unexpectedly, however, the snowmobile also resulted in drastic changes to traditional herding practices; reindeer hated the machines, and rapidly became de-domesticated, so that total herd numbers dropped dramatically and many herdsmen were forced to seek other livelihoods, particularly wage labour (Pelto 1973).

The Navaho, who like the Skolt Lapps had been largely hunters prior to the mid-nineteenth century and then became herders, also have maintained a commitment to mobility. Homestead groups shift location several times a year, in a complex pattern which emerges from 'consideration of grazing, water, wood supply, ritual beliefs, and the dynamics of the homestead group itself' (Downs 1977: 358). Where previously they had relied on horses, cars and trucks rapidly became much more important, and the number of vehicles owned doubled during the time of the study (1960–61) (*ibid*: 376). The need to maintain access to more than one area is not merely the result of the imperatives of a herding economy, but also means that 'individual members can move back and forth to avoid conflict within the group' (*ibid.*: 376).

Aborigines and Mobility

Unlike the Lapps and the Navaho, Aborigines of Central Australia have not made an 'intermediate' economic adjustment requiring the maintenance of mobility, yet they have embraced with enthusiasm all the means available to enhance it, notably the camel for a short period of time, and then the motor vehicle. And far from this shift being a marker of 'modernisation' and the abandonment of traditional practices, Aborigines have used their increased mobility to reinforce and extend some aspects of their pre-European social and economic system. This paper will argue, however, that adaptations brought about during the earlier phases of adjustment to the new economic order were of equal or greater significance for the emergence of present mobility patterns.

Motor vehicles have become an essential aspect of contemporary Aboriginal life in the Centre (and outboard motors in the coastal and riverine regions of the north) for a number of reasons. The importance of access to hunted meat (and to some extent gathered foods) is one: with permanent or semi-permanent settlements there is virtually no game within walking distance. However, the increasing and in some areas now almost complete reliance on purchased food has made the economic aspects of hunting much less significant, although ritual presentations of game animals seem to have remained important.

The 'outstation movement', resulting in the proliferation of extended family settlements, at great distances from reliable supplies, medical facilities and schools, has meant that access to vehicles has become a virtual necessity. Only people living at centralised settlements can survive without them, while prestige and full access to the most important forms of Aboriginal sociality are seriously impeded without a 'Toyota'.

One of the major reasons for mobility is the maintenance of ritual connections. As Kolig has noted, 'Two of the most striking features of present-day Aboriginal religious life are its high mobility and the far-reaching communications network' (Kolig 1981: 109). Access to vehicles (and other forms of transport such as aeroplanes) has increased the intensity and speed of ritual transmission, whole 'Laws' being passed on from one area to another across vast spaces, accompanied by the people who are transmitting them. The present paper is not the place to analyse these proliferating ritual connections, the reasons for them and their implications; however the vital necessity of mobility for the preservation of these practices is one of the strongest factors in the Aboriginal willingness to make significant economic investments in the means of their maintenance.

It is necessary to pause a moment and consider just what is meant by the term 'mobility'. A high level of movement from place to place is characteristic of developed societies because of work practices which separate the domestic environment from the workplace (in contrast with 'peasant' economies where the site of production is also largely the site of consumption). Daily journeys of 30 km are not uncommon for those working in large cities. Yet this movement from home to work does not seem to connote 'mobility'. Rather, the commuter's journey, be it short or long, is a mark of his/her insertion into the structures of contem-

porary society, where the two destinations are part of a single, comprehensible and rational adaptation. Mobility beyond this is generally classifiable into two major types: 'holidays', defined as periods outside the spaces of both 'work' and 'home', and visits to relatives on specified ritual occasions, such as Christmas, weddings and funerals. The only other 'rational' explanations for mobility are those brought about as a result of work-patterns which depend on it, such as fruit-picking, shearing, etc. (occupations often seen as inferior by mainstream society).

Mobility as a consequence of a pastoral economy (as in the case of the Lapps or Navaho) can be similarly understood (although there is evidence to suggest that much more at the cultural/symbolic level is implied in these cases). However, the mobility of Aborigines fails to conform to expectations based on this Eurocentric economic rationality. Aboriginal people will, at no notice, join a vehicle travelling hundreds of kilometres away, taking with them no money and few provisions, and will have no idea of when or how they will return. They may thereby forfeit some opportunity such as employment or may miss receipt of some benefit, such as a pension cheque. They may leave behind medicines which they have been told are absolutely necessary to their well-being, as well as valued goods which they know are likely to be damaged or to disappear altogether during their absence. Although mothers will not leave behind young children, single people, married people (with or without their spouse) as well as couples with older children, or no children, are equally likely to undertake such journeys. Even older children may attach themselves to a passing vehicle and not be seen for weeks or even months.

This behaviour, however, requires at least two conditions: firstly, that the vehicle is in the charge of a relative, and secondly that relatives can be found at the end-destination and intermediate stops along the way. Travelling from place to place can only be undertaken in this apparently haphazard way precisely because an elaborate network of reciprocal exchanges underpins it, whereby relatives accept unannounced visits from one another and provide the wherewithal for the visitor's survival if necessary. And an important purpose of such journeys, even in the absence of ritual, marital or other commitments, is to maintain this structure of reciprocal interdependence by calling upon it.

This could be considered as a continuation of mobility patterns of 'the past' — by which is denoted the autonomous Aboriginal societies prior to European colonisation. This is precisely the viewpoint adopted by those observers who wrote with annoyance or despair of the Aborigines' ingrained habit of 'walkabout'. While an analysis could proceed showing how the economic, ritual and marital patterns of autonomous Aboriginal societies depended on mobility, this would merely be to state the obvious. However, this view overlooks the existence of patterns of mobility which were called into play precisely during the decades when the early structures of European-Aboriginal interactions took place — the periods of cattle-station and mission living in the Northern Territory, northern South Australia and inland Western Australia.

Patterns developed during these phases, far from inhibiting or restricting Aboriginal mobility, in fact fostered it. The movement of individuals and groups was required as a means of ensuring social and economic survival in the absence of fully-articulated mechanisms of social and economic incorporation into the developing frontier society. Because Aborigines were not provided with the means which would have made a more 'localised' existence possible, because the cattle-station economies required workers at unpredictable intervals and in unpredictable numbers, because few other forms of employment were available and cash incomes rested on unpredictable sources (until the introduction of cash payments for welfare benefits), and because housing, education and health services were not provided, none of the pre-requisites for a 'settled' life on the Anglo-Australian model existed.

The fact that Aboriginal social and ritual requirements were relatively well-suited to this pattern meant that a unique adjustment was able to develop, which preserved elements of 'traditional' behaviour, while meeting the minimal requirements of the European economy which were both unavoidable and indeed desirable from an Aboriginal viewpoint. Thus the patterns of mobility which are still evident in much of Central Australia today are based not on a direct preservation of 'the past', but on the reproduction of an Aboriginal social and political economy which has its roots in 'the early days' of European settlement.

Further, given the realities of present-day existence, these patterns have a continuing utility. For as long as Aboriginal people live in the remote regions in areas where there are extremely limited commercial possibilities in mainstream Australian terms, and for as long as they have limited or no access to sources of funding other than those derived from Government welfare programmes, and few or no prospects of social mobility into better employment in urban areas, the Aboriginal economy as it has developed over the past few decades will remain the only option. Two essential elements of this economy are the maintenance of networks of communication across a variety of living-spaces, with associated access to resources at those sites, and the ability to resolve the inevitable structural and interpersonal conflicts thrown up by

contemporary social realities by moving away from them.

Patterns of Mobility in North-western South Australia

Here, then, a body of data is presented for a particular small Aboriginal camp in north-western South Australia in order to elucidate the patterns of mobility and the reasons for it evident at that time. This analysis shows how the presence of a particular set of economic and bureaucratic factors enhanced Aboriginal mobility, and how this meshed with Aboriginal prerogatives in maintaining links to land and access to subsistence resources, resulting in continuous population movement which nonetheless had a definite 'rationality'. Not the least of this was the ability to move away from conflicts when they arose, to assert the independence of the individual and his/her ability to survive elsewhere, and to re-organise population structures at different locations in such a way as to ensure available labour for the sustenance of old people and the redistribution of what cash income was available.

Collection of these data was one aspect of an eighteen-month study of an isolated community living on a cattle-station, Everard Park. This was one of the last stations taken up in the area, being developed only in the early 1950s, while it was one of the first to be purchased for the Aboriginal residents under the dramatic policy changes of the early 1970s. The Aboriginal inhabitants, a mixture of Yankunytjatjara and Pitjantjatjara speaking people, had had long-term contact with other European settlements in the area, notably Ernabella Mission to the north, the cattle-stations to the east and south-east (DeRose Hill, Lambina, Todmorden, Wallatinna) and with towns in the area, notably Oodnadatta and Coober Pedy (see Fig. 1, page 2). Some men and women had undertaken wage labour for brief periods, but these contacts had been far from intensive, and most of the people had largely lived on the area of the cattle-station or nearby for two decades. They had worked for the various Europeans who had developed the station, sinking bores and building roads, and had had frequent contact with residents of Fregon and Indulkana when these settlements were established in the 1960s, the former as an outstation of Ernabella Mission, and the latter as a Government settlement. Most of their relatives lived in 1970–71 at one or other of these places, although some who had come from the West had relatives at Amata, Warburton or other settlements in Western Australia, and some older people had relatives at Finke, Oodnadatta, Coober Pedy or Port Augusta. Decades previously, other relatives had travelled south across the desert and now lived at Yalata, although few contacts were maintained at the time of the study (see Toyne & Vachon 1985, Hilliard 1968).

The community studied was relatively isolated at the beginning of 1970. Although people frequently made their main camp near the station homestead, to be close to medical attention and to stores (largely flour, tea, sugar, jam and a restricted range of fresh foods), this depended on the approval of the station owners, and when cattle operations required it they were told to move elsewhere to live near one of the many other bores on the property. Thus at the beginning of 1970 the camp was located about 50 km from the homestead, not far from the main track to Fregon, another 90 km away.

Population and mobility

For reasons which will become obvious later, it is somewhat arbitrary to describe the composition of the camp population, since it changed so often (cf. Denham 1975). However, there was a core of stable residents, mostly pensioners, and a group of families who were children of the older residents; some among these families might move away, but others would generally return to take their place. In addition, there was a fluctuating group of segregated youths, sometimes numbering as many as twenty, and some childless pensioner couples. Because there was no school or medical facilities, and no store, the camp was not typical of living sites in the area at that time, although it was probably quite typical of the populations on the cattle stations in the period prior to the 1960s when the government programmes of settlement were established.

The population fluctuated in numbers on an almost daily basis, as will be shown below. However there were generally 40–60 people, divided by age and sex as follows (based on camp populations at the end of 1970).

TABLE 1. Population composition by age and sex.

Age	Female	Male
0–10	7	6
11–20	5	11*
21–30	2	2
31–40	4	5
41–50	4	1
51–60	3	4
60 +	3	2
TOTAL	28	31

* includes segregated boys

This population was divided into a number of groupings. There were fifteen family groups. Eight

of these were core residents, who were absent from the camp on infrequent occasions only. Two others were children of core residents, who divided their time more or less equally between the cattle station community and an adjacent settlement where another parent was resident. One family was that of a permanently employed station worker, and usually lived at the station rather than in the camp. Three families joined the camp between March and June 1971 and remained there; one had previously been resident but had moved after a child had died, another had left after a fight and moved to a nearby settlement, the third came from Amata after a fight there. All had siblings or parents in the camp at the time they joined it.

There were six married pensioner couples, and three widows and three widowers, one of whom was continually on the move on ritual business, and the other two of whom were highly mobile. There were six boys in segregation, not all of whom were children of camp residents; some had been sent from elsewhere to live in the boys' camp because it was known for tight social control of youths. However, on occasion the segregated boys' camp numbered as many as thirty.

Under-represented in the population were young families with young children (parents in the 21–30 age bracket). Because of the unavailability of school and medical services, people with young families either preferred to or were told to live at Indulkana or Fregon, although they frequently visited their parents and siblings and with the passage of time may well have taken up residence at Everard Park once again.

Any such description, however, is static and disguises the intense level of mobility which occurred from day to day in the Everard camp. Because of the small size of the camp and the fact that I lived in it, it was possible to collect information on all movements in and out of the camp, of visitors and permanent residents. I collected such data for the whole of the period September 1970 to September 1971, but the records of the period between September 1970 and May 1971 were lost when my caravan burnt down. Hence the full range of annual movement cannot now be re-constructed. However, figures for 100 days in 1971 are available, and although not comprehensive enough for a complete analysis, nonetheless provide a 'window' into the patterns of mobility and the many and complex reasons for it during 1971. Since data of this kind are seldom available, I considered it worth analysing in some detail, recognising fully the limitations of the restricted time period involved. Interestingly enough, examples of all the major events involving mobility nonetheless occurred in this period and demonstrate the multiple factors involved in Aboriginal residence patterns at a time of transition in Aboriginal life in the region.

At the beginning of 1970, there were no motor vehicles available to the camp. However, the community as a whole began to save money for a truck, and by August 1970 had become the proud owners of the 'Red Truck', which had been purchased on their behalf by the station proprietor. Shortly afterwards a group of brothers acquired a 'Land Rover' and an old sedan. However, some men also owned a number of horses, and, more importantly, three camels complete with camel gear, acquired years before from the last camel-transporters in the area (perhaps in the early 1950s). Thus this period in 1970 was a bridge between the use of camels, which had been enthusiastically taken up by many Pitjantjatjara people in the region in the 1940s and 50s, and the adoption of motor vehicles.

Europeans and the cash economy

This period was also a time of greatly accelerated non-Aboriginal activity in the area. Where for decades there had been only missionaries, station-owners, patrol officers, doggers and some other itinerant workers, changes in government policies at both State and Federal level began to result in frequent visits from representatives of the various relevant bureaucracies, usually gentlemen in shorts and long socks who came and went with astonishing rapidity and carried out cursory 'consultations', mostly with whites in the area. Nonetheless, welfare policies which had begun in the 1960s with the assimilation policy began to intensify and change direction again in the build up to the accession of the Whitlam government in 1972. South Australia was in the vanguard of Land Rights policies for Aborigines, and various State government agencies became increasingly concerned with the welfare of the large and still very 'traditionalist' Aboriginal populations in the far north.

In practice, this meant a much greater level of contact between Aborigines and those delivering welfare services. The disastrous state of infant mortality became an issue at this time, and resulted in much more vigorous attempts to monitor the welfare of mothers and babies. At Fregon and Indulkana, health services were delivered by agents of the South Australian Health Department in the form of nursing sisters linked by radio phone to the Alice Springs Flying Doctor Service. These services were extended to the cattle station community in the form of a fortnightly visit from the Indulkana staff, known as 'the Patrol', which brought a nursing sister with scales and equipment for assessing health status, the pension cheques for pensioners and families, and a limited range of

fresh foods such as eggs, oranges, tinned milk and baby foods, designed to improve the nutrition of the target groups. Other goods sold included sandshoes, camp-sheets, and fly-nets to be worn over hats. The visits became weekly shortly thereafter, and parents with young children were expected to be in camp every Tuesday so that their health could be monitored.

Not far behind the pension-week patrol came the station stores truck, bringing what were still called 'rations'. The station management, like all those in the centre and north maintained a store from which the Aboriginal residents could purchase basic food needs. Items were sold for a fixed price, such as 50 cents, one dollar or five dollars, ostensibly to simplify the giving of change. Until the late 1960s, Aborigines had not received their welfare entitlements in cash at all; instead station managers had received a *per capita* sum from Government sources out of which they were to feed and provide necessities such as blankets for the unemployed Aborigines resident on their stations. This created a certain set of expectations among Aboriginal people about the obligations existing between management and residents, which accorded well with Aboriginal ideas of reciprocal responsibility; they provided workers for the management, and the management fed the camp. (For a more detailed analysis, see Hamilton 1972, and cf. Peterson 1977, 1985.) However, the introduction of payments in the form of welfare cheques which then were cashed, from which necessities were purchased, had to some extent materially advantaged the Aborigines but also created resentment and confusion among the older people who still expected to be fed and clothed by the station management as before. Hence the arrival of the station stores truck close behind the Indulkana patrol, and the taking back of large sums of money for rations, was regarded as theft, especially by the old people who lost no opportunity to complain about it to other Europeans, most of whom misinterpreted it as a complaint about the high prices being charged.

Reliable figures for cash income and expenditure were obtained over several sample periods. Prior to September 1971 single pensioners received $32 per fortnight and married couples $28.50 per fortnight each. An $8.00 mother's allowance was paid to widows, and child endowment of $2.50 for the first child and $3.50 for subsequent children. These rates were raised somewhat after September 1971. Child endowment was paid to all families with children, while unemployment benefits were paid sporadically. Men of four households received unemployment benefit for part of the year, while other male visitors receiving benefit were often resident in the community. Eight single men and women were at times employed by the station for generally very low wages.

An estimated total income for the year 1971 from these sources was as follows:

Pensions (age and widows)	$13 879
Child endowment	$ 1 844
Unemployment benefits	$ 5 876
Cash paid to station workers	$ 600
TOTAL	$22 199

While some other cash income was derived from four men who went fruit-picking for two months at the beginning of 1971, very little of this returned to their families. Some other minor sources of income may have not been recorded.

In any case, this figure provides an average *per capita* income of about $444 per annum (cf. Peterson 1985: 91, 92).

While this is a low income by non-Aboriginal standards (at a time when Australia-wide disposable income per capita was $1739, Peterson *ibid.*) it nonetheless provided a significant immediate surplus after staples were procured, in the sense that individuals and family groups were able to retain a considerable portion of this cash income and use it for other consumption purposes. Most prominent among these was the purchase of motor vehicles.

Sample records were kept of expenditures on staple items from the station stores and the medical patrol. For example, during one fortnight in January 1971 when $543.00 was received in cash, a total of only $217.00 was spent on goods, including such things as aspirin, cough mixture, hats, sandshoes and bullets. The balance was not all saved, since part of all cash payments received by many pensioners was sent on to married children living at Indulkana as part of the obligation of parents to support their children. One woman regularly sent between $15 and $20 a fortnight. This practice itself constituted an important part of the local economic system, maintaining exchange relationships with relatives who could later be called on to provide shelter, resources and hospitality in return.

However, during one six month period over $1200 was saved towards the purchase of vehicles. The fact that people could afford to spend relatively little on food was itself related to the availability of vehicles, since a significant proportion of food was procured by hunting with rifles on day or overnight trips. A monthly average of 348 kg of meat-weight from large game animals (kangaroo, emu and euro) was obtained over a twelve month period (range 204–627 kg per month) which averages at around 0.23 kg of meat per person per day. Since this does not include food from other bush sources (goannas, eggs, grubs, fruits) it is apparent that the dietary contribution of subsistence food was significant.

Thus a circle of interdependence existed such that the limited access to cash resources was itself sustained by a fairly heavy commitment of what cash was available to investment in vehicles which permitted an adequate level of consumption from non-purchased foods. (Also important was the purchase of rifles and bullets, although this was a much less expensive investment.)

However, as was the case among the Skolt Lapps, motorised transport also involved other costs, notably fuel and repairs. Although some repairs could be carried out at the station, and also at nearby settlements, in the main repairs were made on-the-spot, using parts salvaged from other vehicles and some brilliant improvisations, such as melted plastic from combs to stop up holes in radiators. The ingenuity of these repairs could only be marvelled at, although the long-term result was a vehicle held together by string and hope; this, combined with the poor conditions of local 'roads' and the general over-loading, meant that the useful life of any vehicle was severely limited. Over the observation period no vehicle lasted longer than four months.

Movement and camp composition: a case study

However, the levels of mobility observable were not due solely to the availability of Aboriginal-owned transport. The insertion of even this remote desert community into a complex network of external relations, largely with bureaucracies located in towns or cities outside the local region (notably Adelaide and to a lesser extent Canberra and Alice Springs), together with the local presence of missionaries, government settlement officers, and the station itself, meant that frequent and regular 'rides' were available on which people could often obtain lifts from place to place.

In addition, some individuals went on foraging expeditions on foot away from the base camp, even using camels, and others set off on foot to visit distant settlements hoping to encounter a car on which to obtain a ride somewhere along the way.

To give a detailed account of these movements over a specific period of time permits us a glimpse of Aboriginal life in the region, and illustrates the complex network of considerations which affected population size and composition, as well as individual choices and the many social factors which accounted for them. Appendix 1 sets out the composition of the camp population, indicating usual residents and temporary visitors, together with the vehicle movements in and out of the camp, and the effects these had on the local population. For brevity I include here only figures for the two months July and August, although figures for four full months were collected. Data for the sample months are typical of the overall period. Even though this was the coldest time of the year, when ritual activity as well as hunting was generally less vigorously pursued, examples of all major activities were encountered in this period.

It is apparent from this brief sample of time that multiple events affected this small community. Most noticeable were the 'patrols' from Indulkana (6/7; 12/7; 19/7; 27/7; 4/8; 14/8; 23/8) which often removed children for the purposes of supervised medical care; in the case of young children their mothers would accompany them, and they would find shelter with relatives until they were considered ready to return.

The requirements of the station management for workers resulted in frequent calls into the camp; young girls would be asked to go to the station to assist in domestic chores, men and boys would be called on to assist with stock work and so on. These tasks would often last only a short time; domestic workers might be called in for extra assistance when the station had a number of visitors, and then returned to the camp a few days later. For example, on 10/7 two men were taken to cut firewood and one woman and one young girl to assist when visitors came to the station. On some occasions a man and his family would be asked to camp out at a bore to carry out necessary repairs. For example on 11/8 two adult male workers returned from carrying out bore repairs, one of whom had been accompanied by his wife, while four single youths were taken back to maintain stockyards.

Visits from Europeans other than station personnel or sisters occurred relatively frequently also. Some of these were officers of various departments. On 12/7, for example, an officer from the South Australian Department of Aboriginal Affairs came with the Indulkana patrol to 'have a look'. On other occasions 'locals' would call in to the camp to renew acquaintance with people there. These included Patrol Officer MacDougall (well known to all Aboriginal people in the area after his decades of service) from Woomera (19/7), the Reverend Bill Edwards from Ernabella mission, who arrived with a researcher Mr Noel Wallace for a brief visit on 1/8, and Jim Downing, from the Uniting Church in Alice Springs, who was visiting the area from 28/7 to 4/8.

The Oodnadatta police also made frequent calls (17/7; 22/8; 31/8). Usually they were on their way through to other destinations in the north-west, but they would call in to the camp to discuss matters such as registration of dogs. People feared the police visits, even though they were on all occasions of my field-work quite innocuous: old ladies would run for the hills accompanied by hordes of dogs, and on one occasion all the children were sent to hide because a rumour had gone around that they were going to be rounded up and taken away to school.

The earlier phases of Aboriginal relations with the police were still strong in the minds of people.

Again, the presence of an anthropologist in the camp created its own consequences. The anthropologist would be asked to take a party of people out camping (7/7; 16/8) and return them later after a period of intense hunting and gathering. Unidentified vehicles occasionally drove through, and the anthropologist would be asked to go and find out who they were, especially since people were extremely alarmed about the prospectors who were searching for opal. (This occurred on 15/7.) The anthropologist's supervisor, Dr L. R. Hiatt, came for a brief visit during the period discussed above (9/8–12/8) and was taken around the countryside on hunting trips.

Other vehicle movement was Aboriginal: on 3/7; 11/7; 12/7; 14/7; 20/7; 23/7; 24/7; 25/7; 26/7; 30/7; 31/7; 6/8; 17/8; 21/8; 24/8; 30/8. Many of these were 'passing through' visits, either from Indulkana towards Ernabella or in reverse. On virtually each occasion the population of the camp changed, with some people being dropped off and others joining the vehicle. The actual figure totals cannot reflect this change, since they give only raw numbers, but even so they indicate the extent of mobility.

The spate of movement towards the end of July was the result of the holding of a very important ceremony at the camp. This meant not only that people came and went through the camp, but that within the camp itself people had to make adjustments. All women with young children had to shift their camps about a kilometre away from the main camp so as to be out of the way of the 'business' (ceremony), which required some major transportation of food, bedding, utensils and so on.

On 29/7 ten adults and eleven children left the main camp for a site about 7 km away. The anthropologist's vehicle was used to transport swags and staple foods and three of the smallest children, while the rest of the group walked, gathering food on the way, resting at a 'dinner camp', and arriving in the late afternoon. People remained at this camp for varying lengths of time, some of the older children walking back after a couple of days. The last family returned on 8/8, in time for the arrival of the Indulkana patrol and the station stores. The expectation of arrival of these vehicles, with associated cheques, money, stores and medicines, punctuated the flow of time and clearly affected people's decisions about the patterning of their activities. On the day these visits were expected, women went early to the bore for water, washed clothes and children, and generally prepared to put on their best 'face' for the arrival of the European authority figures.

These frequent movements both of camp residents (and their visitors) and of other Aboriginal and non-Aboriginal people in and out clearly reflected the multiple available choices for that time and place. However, 'movement' was not limited to this. The camp itself shifted quite regularly. Individuals would move their camp-sites with the associated shelters about every three weeks or so depending on how dirty the area was becoming. People re-oriented the openings of the shelters according to the prevailing winds; in winter this was particularly important with the southerlies sweeping up from the Antarctic. Finally, social relations within the camp determined people's living sites; after an argument or disagreement, shelters would be conspicuously re-located down towards the creek-bed or back towards the hills, which meant close relatives would also move their shelters over time. Thus the camp itself was in a constant state of fluctuation in normal times. When a death of a relative occurred, even a long way away, the whole camp was required to move to a completely new location, shelters to be rebuilt, and new alignments worked out. Sometimes these removals were to places many kilometres away, and required frequent vehicle trips to transport all the camp impedimenta, the old people, the small children and of course the dogs. Many dogs would be left behind to find their own way to the new site, although on one occasion a party of old ladies took two days to walk to the new area so as not to leave their dogs behind.

While from this perspective Aboriginal life seemed a constant process of movement from one camp to another, one settlement to another, one set of relatives to another, there nonetheless was a continuity to the process which only became apparent over time. The people involved in this process were not a random group. They were part of a distinct network which did not include everybody at the adjacent settlements, let alone people from further afield.

When unidentified vehicles arrived at the boundaries of the camp there would be rapid speculation about the identity of the visitors. Aboriginal people who were not close relatives of someone in the camp (for example, someone travelling from Coober Pedy to some point further north), would wait at the camp boundaries in their vehicles until somebody (usually a senior man) arrived to 'sponsor' them in. When a vehicle was driven by a close relative, but contained someone less closely related who had not been seen for some time, the vehicle would drive into the close relative's camping area but the 'stranger' would wait in the car until someone came and spoke to him/her directly.

Over time, the same people would be seen coming and going; sometimes they would stop off and join the camp for a period if they had close relatives

there. This might be said to be *unytju* (temporary), but sometimes stretched into months or even longer, at which point their residence would be focused on this camp rather than somewhere else and they would have their welfare entitlements transferred there. This created problems for those who were previously in the Northern Territory or Western Australia, and people sometimes missed their cheques for months and then received a hefty windfall. In which case, they would, of course, try to buy a car.

One final point of critical importance is the way in which the readiness to move camp from one settlement to another was a fundamental mechanism by which intra-family and intra-community conflicts were 'resolved'. This is a topic which requires a much more detailed analysis than there is space for here. However, there is a fascinating connection between 'conflict' and camp composition, which was apparent on many occasions during the period of field-work.

In the circumstances of life in an Aboriginal camp with no facilities such as reticulated water, electricity, garbage disposal, heating and cooking facilities, the level of physical support necessary to sustain non-able members is considerable. Old people, often with rheumatism and emphysema, people suffering acute or chronic illnesses, mothers with small children, all require a minimum daily quota of firewood, water, and prepared food. When camps include few younger, able-bodied people, the work-load increases dramatically, especially if some form of hunting and gathering is also necessary to maintain satisfactory nutrition. The shortage of able-bodied people becomes even more acute when it is younger people who are always in demand for the pastoral economy.

As population shifts occur such that old people have few younger relatives to call on for support, the level of tension rises, quarrels break out, and the 'morning discourse', when people state their concerns to the camp in general, becomes increasingly heated. The complaints made are general, rather than specific; no names are mentioned, no particular individuals are singled out as not doing enough. Rather, general statements to do with 'laziness', 'not caring for relatives' and so on are made. Inevitably, after time passes without any resolution, someone loses their temper and a full-scale fight breaks out. Often, other matters too are raised, which exacerbates the problem. Old women will raise digging sticks to one another, or old men will stalk about brandishing spears.

News of this state of affairs inevitably travels along to the other settlements; and, with no apparent organisation or specific requests for assistance, one or two young families will arrive in the camp and take up residence for a time, or some adult single men will join the camp on a temporary basis and go hunting every day.

Conflicts arising from other causes will be resolved similarly by one or other of the disputants (and their immediate families) simply moving away for a period of time until the cause of the conflict is resolved or forgotten.

Thus the ability to move from place to place, the lack of investment in items which 'lock' people into one residential area rather than another, and the maintenance of webs of obligation and communication to other settlements and communities all ensure that resources can be re-distributed as the need arises, and that situations which could result in dramatic confrontation are avoided by the simple expedient of going somewhere else.

Without doubt these were important mechanisms in pre-colonial desert society too. However, the insertion of Aboriginal people into a particular form of connection with non-Aboriginal society *via* the pastoral economy enhanced the value of such adaptations, while no alternatives which would have accorded with a more 'settled' mode of adjustment were created. Thus the maintenance of a commitment to mobility came to be embedded within the adjustments of 'the early days' and continued on into the period when white Australia began its most active penetrations into the Aboriginal society of the Central Desert. It would be of interest to compare mobility patterns among people whose past did not include a period of adjustment to the pastoral presence, that is, those who went from a relatively autonomous Aboriginal existence into the large settlements of the 1960s. It may be that mobility remains an important mechanism there too, insofar as few, if any settlements in the remote regions provide the kind of infrastructure which would render unnecessary the maintenance of some level of mobility. The relationship between necessity and desire, however, remains to be explored.

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APPENDIX 1. POPULATION COMPOSITION AND VEHICLE MOVEMENT, JULY–AUGUST 1970.

Date	Men+Vis.	Women+Vis.	Chn+Vis.	Total	Vehicle Movement
JULY					
1/7	7 + 0	12 + 0	5 + 0	24	Nil
2/7	7 + 0	12 + 0	5 + 0	24	Nil
3/7	7 + 3	12 + 3	5 + 6	36	Fregon car with visitors.
4/7	7 + 0	12 + 0	5 + 0	24	Car returns to Fregon.
5/7	7 + 0	12 + 0	5 + 0	24	Nil
6/7	8 + 0	13 + 0	9 + 0	30	Ind. patrol — one family returns.
7/7	6 + 0	11 + 0	7 + 0	24	Overnight camping trip — own vehicle.
8/7	8 + 0	13 + 0	13 + 0	34	Return four single men.
9/7	8 + 0	13 + 0	13 + 0	34	Station truck.
10/7	6 + 0	12 + 0	12 + 0	30	Workers to station.
11/7	6 + 1	12 + 1	12 + 0	32	Fregon car. One couple stay.
12/7	7 + 1	12 + 1	9 + 3	33	Ind. patrol, DAA officer. Car from Ernabella.
13/7	6 + 2	12 + 1	9 + 3	33	Car to Ind. with one woman. Worker returns.
14/7	6 + 1	10 + 2	2 + 5	26	Car from Ernabella. One family stays. Workers and chn to station.
15/7	6 + 1	10 + 2	2 + 5	26	Unidentified car.
16/7	6 + 1	10 + 2	2 + 5	26	Station truck to Fregon.
17/7	6 + 1	10 + 1	2 + 5	26	Police. Truck rets. from Fregon.
18/7	6 + 1	10 + 1	2 + 5	26	Nil
19/7	8 + 1	8 + 1	5 + 3	26	Ind. patrol. Patrol Officer MacDougall.
20/7	8 + 4	4 + 7	0 + 3	26	Fregon car — 'business'. Wom. and Chn to separate camp.
21/7	8 + 6	4 + 1	0 + 4	23	Cars return Fregon.
22/7	8 + 6	7 + 4	5 + 4	34	Wom. and chn return main camp.
23/7	9 + 6	9 + 5	9 + 4	42	'Business' — Cars from Ind.
24/7	9 + 3	9 + 3	12 + 7	43	Cars to Fregon. Car from Ind. with chn.
25/7	9 + 3	9 + 3	10 + 7	41	Ind. car to Fregon.
26/7	9 + 2	9 + 3	10 + 8	41	Male worker to station. Boy dropped off from Ind. car returning.
27/7	8 + 3	9 + 3	10 + 7	40	Ind. patrol.
28/7	7 + 2	9 + 3	10 + 7	38	Station stores. J.D. visits.
29/7	4 + 1	5 + 1	2 + 4	17	Party leaves to camp nearby.
30/7	5 + 1	6 + 1	2 + 0	13	Car from Ind. going to Fregon.
31/7	6 + 0	7 + 0	6 + 0	19	Station truck. One family returns from DeRose Hill.

APPENDIX 1. POPULATION COMPOSITION AND VEHICLE MOVEMENT, JULY–AUGUST.

Date	Men + Vis.	Women + Vis.	Chn + Vis	Total	Vehicle Movement
AUGUST					
1/8	6 + 0	7 + 0	6 + 0	19	B.E. and N.W. visit from Ernabella.
2/8	6 + 0	7 + 0	6 + 0	19	Visitors leave.
3/8	6 + 0	8 + 0	9 + 0	23	Woman and chn return on foot from out-camp.
4/8	8 + 4	10 + 1	21 + 4	48	J.D. returns. Ind. patrol. Stores truck. Some return from outcamp.
5/8					No data available
6/8	9 + 0	11 + 0	22 + 0	42	1 family returns from Fregon.
7/8	10 + 0	13 + 0	23 + 0	46	More camping party returns. Station truck. Ind. sister.
8/8	11 + 0	14 + 0	24 + 0	49	Last camping family returns.
9/8	11 + 0	14 + 0	24 + 0	49	L.H. visits.
10/8	11 + 0	14 + 0	24 + 0	49	Nil
11/8	13 + 0	15 + 0	20 + 0	48	Station workers return from station by station truck.
12/8	13 + 0	15 + 0	20 + 0	48	L.H. leaves.
13/8	13 + 0	15 + 0	20 + 0	48	Nil
14/8	13 + 2	15 + 1	22 + 3	56	Ind. patrol — people return.
15/8	13 + 1	15 + 1	22 + 3	55	Station truck.
16/8	11 + 0	12 + 0	16 + 0	39	Small party to camp out (A.H.'s car).
17/8	12 + 0	13 + 0	20 + 0	45	Ind. car — one family arrives.
18/8	12 + 1	14 + 1	23 + 3	54	Station workers return.
19/8	12 + 0	14 + 1	23 + 3	53	1 worker to station.
20/8	10 + 0	14 + 1	22 + 3	50	Men to stock camp.
21/8	11 + 0	16 + 1	23 + 3	54	3 return from Ind.
22/8	11 + 0	16 + 1	23 + 3	54	Police visit.
23/8	11 + 0	16 + 1	23 + 3	54	Ind. patrol.
24/8	12 + 0	15 + 0	22 + 3	52	Ernabella car passes through.
25/8	12 + 0	15 + 1	22 + 3	53	Nil
26/8	12 + 0	15 + 1	22 + 3	53	Nil
27/8	12 + 0	15 + 1	22 + 3	53	Nil
28/8	12 + 1	15 + 2	22 + 5	57	Family returns from station.
29/8	12 + 1	15 + 2	22 + 5	57	Nil
30/8	11 + 1	14 + 2	20 + 5	53	Ernabella car returns.
31/8	11 + 1	14 + 2	20 + 5	53	Police call *en route* for Docker River.

Ind. = Indulkana.

NOTE: The category 'visitors' refers to people living for shorter or longer periods in the camp, but who were still described as 'temporary'; in some cases their sojourn might be overnight only, in others their residence might stretch into months. Hence it is a relatively fluid category; yet there seemed to be an analytic need to distinguish between those primarily identified with this camp and others.

JUST ONE TOA

L. A. HERCUS

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This paper gives details of what has been learnt from Wangkangurru people of the background of just one toa, that relating to a claypan named *MaRaru* in the Simpson Desert. The evidence confirms the view that the toas reflect the situation and the thoughts of Aboriginal people at Killalpaninna Mission in the first decade of this century.

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The toas are well-known as beautiful and colourful artefacts from the Lake Eyre Basin. The book by Jones & Sutton (1986) gives the historical background as well as handsome illustrations of the toas. Their function has been described as follows:

> The purport of the toas may be described as topographical in the sense that each represents, and serves as an indicator or sign-post to, some particular locality. Their shape, colours, patterns or appendages depict realistically or ideographically, either certain conspicuous or peculiar natural features of the localities represented, or very frequently these details have reference to episodes which are believed to have occurred during the frequent legendary wanderings of the Muramuras.[1] (Stirling & Waite 1919: 111).

The original data on the toas come from the writings of the missionary Reuther, who worked for many years at Killalpaninna on the lower Cooper where not only Diyari people but also people from all other groups of the north-east of South Australia were assembled. Reuther explained as follows:

> When Aborigines travel from one campsite to another, but expect friends or acquaintances to visit them within the next few days, a toa is made relevant to the present camp (the one they have transferred to) informing the visitors that the (inhabitants) have moved for one reason or another to this or that spot (Reuther 1981, XIII: 1).

Whether the function of toas was really quite as practical or whether it was mainly artistic remains uncertain. Reuther's statements convey the view that the toas were ephemeral items, expected to give information to visitors who arrived 'within the next few days', and that some of these items were preserved thanks to the interest of the missionaries at Killalpaninna. The toas captured the imagination of many people and they have aroused interest particularly from the iconographic point of view, as in the work by Morphy (1977). There are however many problems that remain unanswered. The aim of the present paper is to examine the background of just one toa in an attempt to define more closely some of these problems — not necessarily to answer them, and to give some indication of the place of the toas in the mythology of the Lake Eyre Basin. The one toa is *Mararuni*, No. 14 of Stirling & Waite's collection, No. 121 of Reuther's list, No. 362 in Jones & Sutton's publication. The additional information used for this paper stems from work carried out from 1965 onwards with older people, now deceased, of Wangkangurru, Arabana, Yarluyandi and Diyari descent. They had extensive knowledge of the traditions of the Lake Eyre basin.

The Distribution of Toas

The attribution of the toas to various 'tribes' is itself of great interest, in that they are mostly Diyari and Wangkangurru, with a number of Yawarawarrka, Ngamani and Thirrari. There are only a couple each attributed to Pirlatapa, Yandruwantha, Wangkamadla and Yarluyandi people, only one each for Kuyani and Arabana, none at all for Karangura. The distribution of toas among the different people and the relative frequency or rarity of toas for particular areas does not appear to correspond to any other known lines of demarcation, linguistic or otherwise. The Lake Eyre Basin was an area of much cultural and linguistic diffusion: this is one of the most fascinating aspects of the region. Basically however, the languages of the Lake Eyre Basin and the adjoining area of far south-west Queensland belong to two different groups and four different subgroups (see Fig. 1).

The distribution of toas does not relate to any of the fields of similarity either genetically as in the diagram shown above or through lines of linguistic diffusion. Thus for instance Arabana and Wangkangurru are dialects of the same language, and the people had close ritual, social and cultural ties. It is difficult to imagine that there would be anything that the Wangkangurru language or the Wangkan-

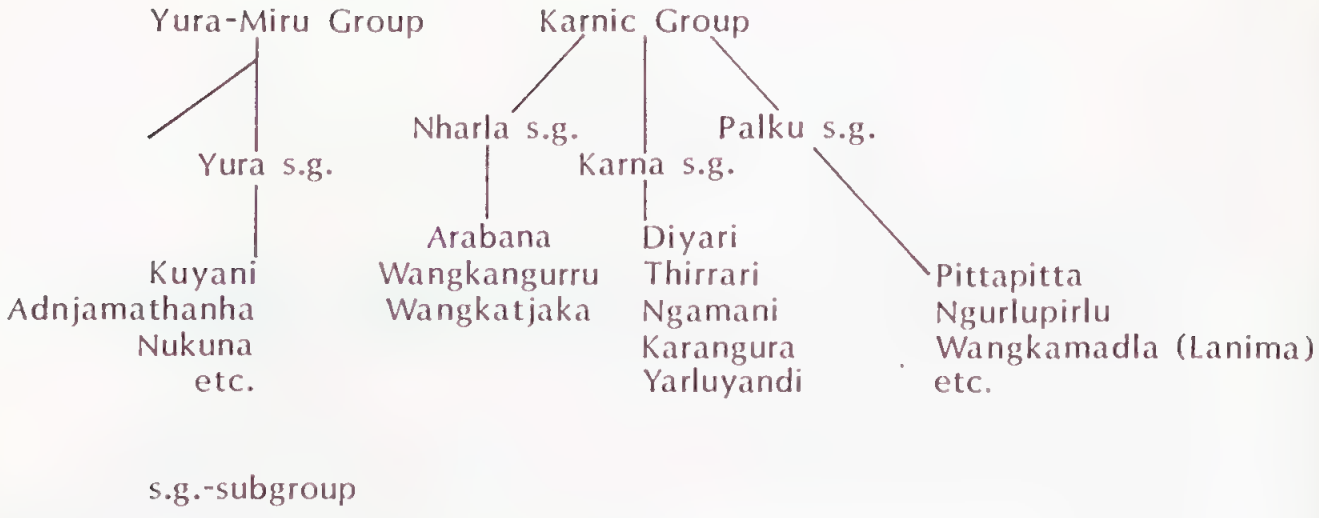

FIGURE 1. Language relationships in the Lake Eyre Basin.

gurru cultural system would share with Diyari but not with Arabana. What then brought about the existence of numerous Wangkangurru toas as opposed to the one solitary Arabana toa? The answer seems to point in the direction of availability of these objects at Killalpaninna at the time that the missionaries became interested in toas.

Karangura people were closely associated with Ngamani people. There are plenty of Ngamani toas, but none are Karangura. The absence of Karangura toas may be due to the fact that there were very few Karangura people left by the turn of the century. The late Mary Dixon (Diyari) occasionally spoke of them: she was at Killalpaninna from the beginning of the century on as a young married woman and even learnt a Karangura song from these last people. It seems probable however that they had all gone by the time interest awakened in the toas a few years later.

The toa 'Mararuni' belongs to *MaRaru*, a Wangkangarru site in the Simpson desert. Wangkangurru people had gradually begun leaving the

FIGURE 2. Mick McLean Irinjili in the Peake Ranges 1968 (photo G. R. Hercus).

desert in the latter decades of last century and the last groups left in 1899 (Hercus 1986). The oldest of the people who were alive in the sixties, Mick McLean *Irinjili* (see Fig. 2) and Maudie Naylon *Akawiljika* had clear recollections of their childhood and youth, living in the desert without any direct white contact. Maudie had subsequently moved to Killalpaninna and lived there for some time. She knew the Rev. Reuther. Other slightly younger people had considerable indirect knowledge of the Simpson desert. Nevertheless even the oldest of the people who showed so much knowledge of language and traditions had no knowledge of toas. They did not know the word 'toa' in Diyari nor in any guise that it might have had in Wangkangurru. On the basis of:

Diyari 'noa' = Wangkangurru *nhupa* 'spouse'

I had tentatively tried to suggest a Wangkangurru word 'thupa' but without any success, as no one had heard of it. I tried to describe toas but again I drew a blank. There might have been such objects, they agreed, but none of the people really knew.

It is difficult to understand why, amid so much traditional knowledge, there should have been such ignorance about the toas. I was forced to the conclusion that toas were rarely used in traditional days and became of interest as artefacts only in the early years of this century.

The Site at *MaRaru*

On the very last major field-trip that Mick McLean undertook with us in August 1975 in the Simpson Desert he talked at length of the site at *MaRaru.* Speaking in Wangkangurru interspersed with some English phrases he said[2]:

Text

MaRaru ngura katjiwiRi. Malkara. ngura katjiwiRi puthu pirda-lhuku
MaRaru camp great. Malkara. Camp great dish beat-PURP

puthu. maRa-ru. puthu pirda-rna kaRu right round *thangka-rda*
dish. Hand-with dish beat-IMP there sit-PRES

irlanha pirda-lhuku maRa-ru, mudlu uka-nha nhanhi-lhiku. mudlu
thus beat-PURP hand-with sandhill it-ACC see-PURP sandhill

kaRu thangka-ngura warpi-nangka-ngura mudlu wantantara.
there sit-CONT lay-CONT S-CONT sandhill very high

L[3]: *mudlu nguru mudlu nguru?*
sandhill other snadhill other?

M: *mudlu wila-wila wadlhu parlu idni-ngura muthu*
sandhill many place flat lie-CONT like

like that plain right along, I don't know about now, might be grass over, I don't know,

waru-ki-thiya! yarndi malka anti-nganha! anth-irda
long, long ago of yore not now-from! me-LOC

thutirla-rga njarinjara-nga anha ngunta-ka wadlhu wathili anthunha-ru
boy-LOC small-LOC me show-PAST country own mine-by

anja-ru uka-kunha pula-kunha wadlhhu mathapurda nguru-ku mathapurda
father-by. He-of both-of country old man other-of old man

parkaya-kunha pick'm up there *thangka-thika-lhuku walta thika-lhuku' kaRu*
rat-kangaroo-of sit-return-PURP time return-PURP there

uka-kunha-ruku ngura-ruku.
he-of-to camp-to.

L: *thutirla karna-ma-lhuku?*
Boy man-make-PURP?

M: *katha-nangka-rda nhatji-rna-tharka-rna pula-ru nguyu-nga ularaka*
Go-CONT S-PRES see-IMP-stand-IMP two-by one-LOC History

wangka-rda mathapurda Ngudluwaltu-ru all *witha* there *witha*
sing-PRES old man Wallaby-by boss boss

katjiwiRi Ngudluwaltu witha pirdayi-ngura uka-ru tharka-ngura
big Wallaby boss. Beat-CONT him-by stand-CONT

pita-pita marlka-marlka. mathapurda kidni kidni-pula mathapurda
chest stripe Old man great great-two old man

Ngudluwaltu two partners, *karna-pula mathapurda-pula yadningka*
Wallaby man-two old man-two young man

wila-wila-purru-thu, yadningka parkaya ngudluwaltu yadningka
many-having-indeed, young man kangaroo wallaby young man

wila-wila pula-kunha arluwa-thu. uka minka-hi pantu-pantu not *pantu*
many both-of child-indeed. It something small lake not lake

they reckon he been *wadlhu ngurku puthu idni-ka*
country good dish be-PAST

about 40 men sit round'm *pirda-lhuku maRa-ru.*
hit-PURP hand-with.

L: *wadni wangka-lhuku?*
ceremony sing-PURP?

M: *ularaka wangka-lhuku,* not *wadni, ularaka.*
History sing-PURP ceremony, History.

L: *ularaka, uljurla padni?*
History woman none?

M: *wangka-rda uljurla yaka-yaka-rinaru, kari thika-rna ngura-ruku*
Sing-PRES woman chase-away-having, they return-PRES camp-to

thadlu mathapurda kari mapayi-lhiku pirda-lhuku.
Only man they sit-PURP beat-PURP.

wanti kanhangarda thangka-ngura kudnangkari-ku tjarlpa kari
corkwood there stand-CONT south-to tree they

tharka-arka-ngura wanti-thi wila-wila.
stand about-CONT corkwood many.

I don't know about now, might be like this! Many many years ago.

Translation

MaRaru was the main ground, the Malkara ground. It was the main camp for striking a large wooden dish. They used to strike it *maRaru*, 'with their hands'. They were looking at this sandhill. There was a sandhill there. A really high sandhill lay there.

L: There was sandhill upon sandhill?

M: There were many sandhills. But there was also some flat bare ground, like that plain here (i.e. the Makari air-strip), but I don't know about now, there might be grass on it. I don't know, it was so long ago, way back in the past, not recently! When I was a young boy my father showed me this, my own place. It was the place of both those two (the Two Men) including that other old man, The Rat-Kangaroo, he picked up *Ngudluwaltu* (probably the Crescent Nail-tailed Wallaby, *Onychogalea lunata*) to come back and stay in his own camp (at *MaRaru*).

L: To put boys through the rule?

M: They walked about. They stayed and watched and sang the History together, the Crescent Nail-tailed Wallaby did the singing. All the ritual leaders were there, and the biggest leader of them all was the Wallaby. He started beating a big wooden dish, he with the stripe on his chest. He was the main one, along with the Rat-Kangaroo. There were two of them, the Two Men, the Two Old Men. They were there together with a big group of young men, Rat Kangaroo men and Crescent Nail-

tailed Wallaby men. They were the children of those two. There was a bit of a lake, not really a lake (but a claypan). They reckon it was a good ground; about forty men sat in a circle beating wooden dishes, *maRaru* 'with their hands'.
L: To sing a ceremony?
M: To sing a History[4], not a ceremony, a History.
L: A History, with no women present?
M: They sang after they had got rid of the women. The women went back to camp. Only the men sat together beating their wooden dishes.
Corkwood trees grew there, there was a stand of them on the south side. I don't know about now, it might be (treeless) like this (i.e. the air-strip)! It was many many years ago (that I saw it). .

Unfortunately Mick McLean became seriously ill and we could not get to *MaRaru* on that final trip with him. There are only limited literary references as to the whereabouts of *MaRaru*. . It is shown on Hillier's map (Hillier MS), but the Simpson Desert sites are given more or less as a list on that map, without proper geographical reference, as none was available at the time, not even the saltlakes of the eastern Simpson are shown. Howitt & Siebert gave a vague indication of the whereabouts of *MaRaru*: 'The place *Mararu* is said by our Wonkanguru informants to be not far from Birdsville, in a southwesterly direction' (Howitt & Siebert 1904: 110).

MaRaru is in a south-westerly direction from Birdsville, but not close at all. We have much greater detail from Lindsay, who obviously heard the name on his journey across the Simpson Desert in January 1886. In his journal of the expedition, while describing how he travelled from the Beelpa native well to the Balcoora well he states: 'then good plain 1 to 3 miles north, Mourowrooinna plain'. Describing his return journey he says: 'keeping a bit to the north, crossing a main sandhill Tarrabulla and the Mawrowrooinna plain' (Lindsay MS). This is no doubt his way of transcribing *MaRarunha* (for the final *-nha* see below).

We have Mick McLean's account, quoted above, of what *MaRaru* was actually like. Both he and the other old people who had been in the Simpson Desert gave additional information. *MaRaru* was a small claypan at a point where several sandhills ran together either on or close to the *MaRaru* plain. There was no permanent water at *MaRaru*, and it was made clear that rituals at this site took place only when there was some surface water about after rains. The *MaRaru* plain is a favoured location, it is like a vast valley between sandridges. It is well vegetated mainly with salt-bush, but after rains it is beautiful with an abundance of flowering cassia bushes, clianthus, and all the usual desert wildflowers. I had travelled on a number of occasions through the *MaRaru* plain on the way to the Beelaka, i.e. the *Pirlakaya* native well, but I had never had a chance to search for the famous claypan on the ground: the late Mick McLean confirmed the general location of the site from the aircraft when we flew over with Robert Ellis in 1975. It was not till July 1986 that, with the help of the South Australian Aboriginal Heritage Unit and the assistance of Peter Clark with his light plane, we ultimately found *MaRaru* (see Fig. 3). The four fingers (the sandhills) were clearly visible from the air, and it was located at the north-western edge of the plain. The site had been narrowly missed by a seismic line, but as soon as we approached from the south it became obvious that here was a very special place indeed. The claypan is sheltered from view by the sandhills and forms a secluded arena where rituals could take place: nobody could have approached the site without being seen from afar from the top of one or other of the four sandhills. There are signs of occupation all around the area, including a few fragments of grinding stone. This confirms Mick McLean's statement that women were permitted at the site until the ritual actually started.

Reuther, when describing the toa, must have sensed some of the enthusiasm of Wangkangurru people about this site. His usual painstaking reporting gives way to what he himself implies are flights of fancy:

> On coming to this place Wutjukana found a gorge in the local hills with four minor gullies. . .In wetter years small streams trickle down from these gullies, these we find (illustrated) on the toa by way of row upon row of red dots. All these streams trickle together into a deep waterhole (red) at the bottom of the toa. No wonder that these dark ('black') inhabitants of the desert retreated to such a spot in times of drought! (Reuther 1981, XII: 121).

Ironically the fact is that the Wangkangurru did *not* visit *MaRaru* in times of drought: they stayed by their underground wells, the *mikiri*, which did have permanent water. It must be remembered that there is no permanent fresh surface water, there are no rocky hills in the central Simpson desert and no creeks anywhere in Wangkangurru country, apart from the lower Diamantina and the Kallakoopah — a look at any map will confirm this. Reuther had never visited the central Simpson Desert which in those days was inaccessible, and he therefore interpreted the sandhills as hills and the claypan as a waterhole. The landscape indicated by the toa is different from what Reuther could have imagined, but the basis of his information from Wangkangurru people was of course accurate, in wetter years there would indeed have been tiny streamlets ('Wæsserlein') dripping down in small gutters between the sandhills: these were the weather-conditions in which Wangkangurru people longed to see *MaRaru*.

FIGURE 3. The MaRaru claypan (photo L. A. Hercus).

MaRaru and the Two Men

The toa 'Mararuni' refers to what is probably the place with the greatest ritual significance in the whole of Wangkangurru country: *MaRaru* is the main Simpson Desert Two Men Initiation History site. In Wangkangurru mythology, as mentioned above by Mick McLean, the Two Men are identified with *Ngudluwaltu* (probably *Onychogalea lunata*, now extinct in the area), and *Parkaya* (*Caloprymnus campestris*, the now totally extinct desert rat-kangaroo). There is a song cycle about their activities at *MaRaru*, and there are also long lines of song radiating out from there, and connected with the journeys of the Two Men out from the desert to instruct other people to the east and the south-west. There is also another 'line' which was felt by Mick McLean to be the finest in Wangkangurru literature: the ascent of the Two Men into the sky, walking up to the clouds and beyond. It was his favourite song cycle.

Because of their ritual importance the Two Men from *MaRaru* came to be known by all the major authors who studied the mythology of the area: Elkin gave an outline of the story of *MaRaru* and the Two Men in his manuscript notes (see Hercus & Sutton 1985: 23). Howitt mentions the MaRaru site in his *Native Tribes* (1904: 783) in Siebert's appended legend of 'The Wanderings of the Yuri-ulu' i.e. the Two Men. The story of the Two Men from *MaRaru* is furthermore given in some detail by Howitt & Siebert (1904). This article even contains a footnote giving an explanation of the name which is grammatically and semantically acceptable and is in fact identical with that given by Mick McLean: '*Mararu* is to complete with the hand, to strike the *pirha*, that is to strike the up-turned wooden bowl, in a dance. *Mara* is hand and "*ru*" is the Wonkanguru causative termination, which is in the Dieri "*li*" as *mararu, marali*' (Howitt & Siebert 1904: 110).

A variant of this explanation is given by Reuther (1981, VII: 1195) in his list of place names:

> *Maráruna*, Wkml.
> *Mara* = 'hand', runa = 'the back, the obverse side'.
> Meaning: 'to beat with the hand on the obverse side'.
> Whilst performing a sacred ceremony here *Pitikirina* beat time with his hands on the obverse side of a coolamon. This is still the practice to this day, and is the reason for this place being (so) named.

From this explanation it is clear that Reuther was fully aware that this was a ritual site, but the

Ancestor named here, *Pitikirina*, does not figure anywhere else in Reuther's work as a person, and is not one of the known names of the Two Men. There is however a Ngamani placename *Pitikiri* which is explained as meaning 'to show one's backside' (*piti-* 'backside', *kiri-* 'to show' VII: 1631). This leaves little doubt that here we have a case of Reuther giving a nickname instead of the standard name of an Ancestor. There are other well authenticated instances of this, *Wurru*, the important Crane Ancestor whose chants were sung by Mick McLean is referred to by several different names in Reuther's work, never by his main name, *Wurru*. One of these nicknames *Ngampali-Ngampali* 'burying' would be totally inexplicable and we would have no idea that it referred to the Crane were it not for Mick McLean's song-cycle: in this the wicked Crane having himself caused a great heatwave constantly asks to be buried in damp sand. Similarly *Pitikirina* seems very much like a nickname perhaps referring to one of the more humorous aspects of the story of the Two Men.

The story of the Two Men, central to Wangkangurru traditions, is not directly mentioned by Reuther in connection with the toa. He associates the site with a minor matter connected not with *Pitikirina* as in VII: 1198, but with an ancestor named 'Wutjuka'. 'The *muramura* Wutjukana had a servant (*mili*) whose index and middle fingers had grown together. Therefore the middle finger also appears thicker on the toa' (Reuther 1981).

'Wutjuka' in fact appears to be a joint name for the Two Men. The Two Men of Wangkangurru tradition always travel as a pair, and on the few occasions where 'Wutjuka' is mentioned elsewhere in Reuther's writings he is on his own with just the usual 'followers'. The name 'Wutjuka' is confirmed as a name for the Two Men by Horne & Aiston (1924: 162) who call him 'Wutraka', and speak of him in the singular, ascribing to him the introduction of circumcision by means of a knife at Karlamurina, an event that is a major episode in the song cycle of the Two Men. Reuther was familiar with the story of the Two Men and even knew about their ascent into the sky (1981, XI: 108). He calls them 'Malkumalku-wulu, the Two Young Men'. Whether he chose to call the Two Men, 'Wutjuka' or anything else, in discussing the toa Reuther did *not* connect the main myth with *MaRaru*, only the minor incident.

There are two problems connected with the actual site at *MaRaru*: why did Reuther say that the site is Wangkamadla (1981, VI: 1195) but list the toa as Wangkangurru? Why did Reuther give an explanation for the place-name (*ibid.*) that is different from the explanation for the toa (1981, XII: 121 and 1981, XIII: 121)?

The answer to the first question is not hard to find: the site at *MaRaru* was well known outside Wangkangurru country because of the extensive travels of the Two Men. Wangkamadla people had a very special association with the *MaRaru* myth as the Two Men figure in a long song cycle, partly Wangkangurru and partly Wangkamadla, called the *Wapiya*, sung to us by Mick McLean in May 1968. In this the Two Men have come in company with the old people and with their young brother *Thiwi* 'Spark' from *MaRaru* to Wangkamadla country to a place called *Kudnara* 'With faeces' (for which we do not have a toa). The place is so called because the locals, who don't like outsiders, vent their ill-feeling on the younger brother and keep pelting him *kudnara*. The Two Men clean up young *Thiwi* but when it happens again and again they get more and more angry and finally call over the ancestral Fire which is burning far away to the north. They ask their own old parents to dig a deep pit and get way down into the cool earth while they go up on a sandhill calling up the fire. 'What are you two looking at?' say the locals in Wangkamadla. 'We are just watching a distant excrement of fire (i.e. smoke)' say the Two Men, answering in Wangkamadla with a pointed hint at what has been going on at *Kudnara*. Finally the fire races up and destroys the whole camp and incidentally *Thiwi* as well, and it burns away along the Diamantina. Because this was a very major Wangkamadla myth Reuther could well have heard the name *MaRaru* from Wangkamadla people. As the geography of Wangkangurru and Wangkamadla country was of necessity a mystery to him he cannot be criticised for assuming that the site was Wangkamadla.

It is harder to explain why there should be divergent explanations for the place-name and for the toa, and why the Ancestor connected with the toa should be called 'Wutjuka' and the one connected with the site should be called 'Pitikirina'. The differences reflect Reuther's honesty in reporting: he did not make changes to avoid major discrepancies in his subject matter. It seems likely that over the many years that he was at Killalpaninna Reuther collected his data piecemeal. On account of the many nicknames used it seems likely that some of the Aboriginal people who spoke to the highly respectable Reuther, could not resist making a few jokes calling Ancestors by either rude or esoteric names.

Divergences between the explanation of a place-name and the corresponding toa are common in Reuther's work. Of all place-names the one he knew best was no doubt Killalpaninna: he lived there for eighteen years. The name was *Kirla-wilpa-ni-nha* in Diyari and meant 'vagina'. Reuther was so unhappy about this that he ended his brief comments to the mythological background of the place name (1981, VII: 643) with the exclamation 'O depraved heathendom!' Yet in the discussion of the toas we hear nothing of the myth about the place name and

nothing even of the old woman ancestress whose *kirla-wilpa* was involved, only the male *muramura* of the story, who admittedly is called Kirlawilina, is mentioned: 'The white part of the toa represents a hill. The two small dots are caves leading into the hill. It is believed that the *muramura* Kirlawilina emerged from the earth via these caves. Hence the place-name' (Reuther 1981, XIII: 63).

In XII: 63, in the description of the actual toa the explanation becomes positively romantic and the real meaning of *kirla-wilpa* is not mentioned: this is hardly surprising in view of the revulsion felt by Reuther. The legend that follows appears highly contrived. The emphasis as in the case of *MaRaru* is on the place, not on the original myth.

Reuther's derivation of the place-name *MaRaru* from the notion of hitting a coolamon with the hand during a ritual dance, fits in with Howitt & Siebert's account (1904: 110) and is confirmed by what we have learnt from Mick McLean, above all it gives at least a hint of the place being a major ritual centre. The explanation given for the toa on the other hand looks much more like an *ad hoc* creation: it fits the toa and it fits in with what we know of the appearance of the site, the sandhills running together. Amazingly, it gives no indication of the real importance of the site, and this in itself teaches us a lesson: toas were intended above all else to depict a *place*. The name of a place always had some mythological implications, and these are usually reflected in the toas. The toas however are not an inventory of myths, or else the most famed myth of all would have been mentioned.

Problems of Attribution

Mararuna (Reuther 1981, VII: 1195) is a rare instance of a *site* being attributed to one group whereas it belongs to another. It happens frequently however that toas are attributed to one group when the linguistic evidence and what we know of the location of the site belongs to another group. This makes sense: why should people only make toas for places in their own country? A group might well have gone off to a ritual at a site in other people's country and depict that place in a toa. Examples are shown in Table 1.

In the case of *MaRaru* there was a discrepancy in Reuther's work. In the instances just cited and in several others there is not necessarily internal discrepancy in Reuther's work; linguistic and ethnographic information however tells us that the attribution of the site is not accurate. The inconsistency over *MaRaru* and the other apparent mistakes in attribution can be explained by the fact that Reuther only gave the tribal affiliation of the people who were the *source* of a particular toa and of the relevant information. These people may or may not have been the traditional owners of the sites in question.

The Name Mararuni

There is some minor discrepancy in the spelling. The toa is called *Mararuna(ni)* in Scherer's translation of Reuther 1981, XII: 121. Stirling & Waite read it as *Mararuni* (14). It appears as *Mararunani* in Reuther 1981, XIII: 121. The site is called *Mararuna* in Reuther 1981, VII: 1192.

Reuther explains in the introduction to Volume XIII that 'the suffix *-ni* is appended to every place-name which a toa describes. The *-ni* (respectively *-ri*) denotes the correlative (i.e. demonstrative) pronominal adverb to some distant place yonder; in that direction (Lat. *eo, illic*).'

-ni, i.e. *-nhi* is in fact the allative, 'direction towards' marker in Diyari (Austin 1980), but is not normally used with place-names. These have the suffix *-ngu* instead: the use of *-nhi* with toas is therefore surprising. The use of *-nhi* with Wangkangurru toas is even more surprising: the Wangkangurru language simply does not have a suffix *-nhi* or anything remotely resembling it. In Wangkangurru the allative case is invariably expressed by the suffix *-ruku*, which takes on the form *-riku* after nouns ending in *-i*. Reuther says that the ending *-ni* 'is appended', which we can only interpret to mean that *he* appended it to the name of every toa, regardless of what source it came from. Because he was dealing with an ethnological collection, he consciously imposed a uniformity which he himself (because of his mention of *-ri*) realised did not correspond to the original sources. This is out of keeping with his normal attention to detail, but the collection of toas was something special.

TABLE 1. Attribution of toas.

Toa	Group to whom toa is attributed	Group to whom site is attributed in Vol. VII	Group to whom the site belonged
Dakungarangarani	Wangkangurru	Wangkangurru, Ngamani	Ngamani
Katarungkangamani	Wangkangurru	—	Ngamani
Dakuworduni	Wangkangurru	Wangkangurru	Ngamani
Warukatiwalpini	Diyari	Diyari,Wangkangurru	Wangkangurru
Ngapangandrini	Diyari	Diyari	Pirlatapa

-na is the proper noun marking suffix *-nha* which is wide-spread in the Lake Eyre Basin and beyond. It was used in Wangkangurru optionally in the absolutive case of proper nouns, and particularly with place-names when they were quoted or referred to for the first time in a conversation. *-nha* is thus a case suffix in itself and can never be used with any other case marker following it. Therefore *Mararuna* is the correct way of naming the site at *Mararu* (*MaRaru*), *Mararuni* is Reuther's artificial way of referring to the toa. This is unacceptable for Wangkangurru, as he himself realised. *Mararunani* is doubly wrong as it not only contains the unacceptable *-ni* but adds it after the *-na* which can by its nature never be followed by another suffix. These variants arose simply from the need felt by Reuther to 'append' the suffix *-ni* to the name of all toas.

As regards the explanation of the name, the derivation given by Howitt & Siebert quoted above is completely in keeping with Wangkangurru grammar. *maRa* means 'hand' and *-ru* is the instrumental marker.

Reuther's derivation of the supposedly Wangkamadla place-name (1981, VII: 1195) from *mara* 'hand'; *runa* 'the back, the reverse side' must be based on a misunderstanding as there is no word '*runa*' in any of the languages of the area, and in any case *r-* is not found as an initial consonant in any of the languages of the Lake Eyre Basin.

The explanation given for the name of the toa at X: 121 is quite different: *mara* — 'hand' *-ru* derived from *nguru* = 'strong, immovable firm etc,' and *-na* = 'to, towards'. Reuther knew a great deal about Wangkangurru as is indicated by his grammar in Volume IV, but he had difficulties — just as I did for quite some time — in hearing the differences between the *three* different *r-* sounds in the language. The word for 'strong' as in the language name Wangkangurru is *ngurru*, with a trilled *r-* sound normally transcribed as *-rr-*, but the second *r-* sound of *MaRaru* was usually pronounced as a flap, transcribed as *-r-*. In any case, abbreviations of the kind *nguru* > *ru* are alien to Wangkangurru.

Work on the Wangkangurru language carried out over the last twenty years leaves me with no doubt that Howitt & Siebert have given the correct derivation of the place-name. Both of Reuther's derivations of the name are not grievous errors, but simply brave attempts that misfired. After all *MaRaru*, containing as it does an instrumental case-suffix, was a most unusual type of name.

Mick McLean *Irinjili* often maintained that many place-names were simply names, and did not need to be explained. 'Why shouldn't we have just names for places, the same as whitefellows?' This applied particularly also to personal names many of which were derived from songs and did not have an explanation in terms of everyday language. They did not have a 'meaning' in the ordinary sense of the word, though they could evoke mythological concepts. Naturally Mick McLean knew that *MaRaru* meant 'with a hand', but he preferred to think of it as a name, the name of the place that meant most to him in the whole of his country, apart possibly from his birthplace, the native well at *Pirlakaya*.

Why not 'Mararuni'?

One of the most puzzling questions is why there are toas for some places and not for others. There does not appear to be a ready answer. It is tempting to assume that it was a matter of accident and that it all depended on which toas happened to be around at the time the missionaries became interested. This is no doubt part of the answer, but certainly not all, there were reasons behind the accident:

As we have noted above, the toa 'Mararuni' refers to a major ritual site where there is no permanent water: the main camp-sites for Wangkangurru people in dry weather were the *mikiri*, the native wells. Different local groups moved between different sets of wells.

At least twenty-one *mikiri* wells are known to have existed. Eighteen of these appear among the place-names of Volume VII, though in most cases Reuther was not aware of the fact that they were wells. Because these *mikiri* were such a vitally important resource for Wangkangurru people, it is not surprising that they were also important sites from the point of view of the Ancestors. They are all not just camp-sites, but also major mythological sites (Hercus 1986). Some of them were naturally more important than others to the Wangkangurru of the Central Simpson Desert. There is however one that they never spoke of, it was evidently not one of the normal Wangkangurru camping sites, because it was far away to the east, close to the border of Yarluyandi country. This was *Puramani*. It is known from only one, though very reliable ethnographic source, a manuscript of N. B. Tindale (1934). There is said to be a reference in an MS of the surveyor L. A. Wells, but a check of this work revealed only a reference to a more westerly well *Yalkiri*, not to *Puramani* (Wells MS). Tindale had spoken to a part Wangkangurru, part Aranda man named *Ngaltja-kintarda* or 'throwing spit', the father of an elderly Wangkangurru man still living, Johnny Reese *Njanpika* who was born at the Koonakoo waterhole on Alton Downs about 1901–2. *Ngaltja-kintarda* gave an account of a route across the Simpson Desert from Pandie Pandie on the Diamantina to Dalhousie Springs. Via this route the 'Puramanei mikari' is reached after four and a half days' walk from Pandie Pandie. Tindale notes:

'This place is in Queensland over the border fence separating Queensland and the Northern Territory . . . It is a soak or one of several timbered by the surveyors who surveyed the border (Reese)' (Tindale 1934).

The name in brackets means presumably that the information about the surveyors came from one of the pioneers of the district, 'Lew' Louis von Roon Reese, who owned Minnie Downs and Miranda, and knew the whole area well for many years (Litchfield 1983: 155 and Horne & Aiston 1924: 144) The route described by *Ngaltja-kintarda* continues from *Puramani* to 'Jalkerie mikari', which is shown on maps (Series R 502, 1:250 000, SG 54.5, 653 797). This would put *Puramani* roughly around TS 5045 on the new SG 54.5.

Of the 21 native wells known and the 18 that Reuther lists among his place-names there is only one toa that refers to a native well and that well is *Puramani*. Reuther was obviously thinking of the landscape of the Cooper when he wrote about *Puramani*: 'In this creek the *muramura* Kurkalina once cleaned mud out of a hole with his hands' (1981, XIII: 63).

There is no creek, only a *mikiri*. It seems surprising that the well that nobody mentioned and no one showed any interest in should be precisely the one that merits a toa. Tindale's notes give us a clue: *Puramani* was the first well on *Ngaltja-kintarda*'s route, it was the well closest to Pandie Pandie and therefore the easiest of access for any homesick Wangkangurru at Killalpaninna who wanted to camp by a *mikiri* again.

There are a lot of Wangkangurru toas in Reuther's list, but practically all refer to sites that belong to the Wangkatjaka group of Wangkangurru, sites along the lower Diamantina and the Kallakoopah, and not sites in the real desert. Wangkangurru people were realists: when presumably in 1905 or thereabouts the missionaries at Killalpaninna expressed an interest in toas, they produced toas that suited the situation *of that time*. Wangkangurru people were homesick for their own country of the high sandhills and for the *mikiri*: we know that some of them, presumably those that were then living at Dalhousie, went back after 1900 to the westernmost *mikiri* at Murraburt, we know that from the vast amount of rabbit bones we found at that *mikiri* (Hercus & Clark 1986). They could well have gone on similar camp-outs to the easternmost of the wells *Puramani*, or at least think of such a trip sufficiently realistically to make a toa. They did not envisage returning to live at their main wells in the central Simpson Desert and in fact they never returned to live there again. This is corroborated by the absence of rabbit bones at those wells. It is quite likely however that they could have planned or even carried out an initiation ceremony at their main site at *MaRaru*. They might have called or thought of calling at the Beelpa well *en route*, but we do not know this as a toa only gives an indication of a destination, not a route. What we do know is that of all the central Simpson Desert sites only *MaRaru* has a toa, and of all the wells only *Puramani* the easternmost one has a toa. The distribution of the Simpson Desert toas of the ethnological collection therefore does *not* reflect the living and travelling patterns of ancient times but clearly points to the situation that existed towards the end of the first decade of this century.

Endnotes

1. *Muramura* is the Diyari word for an Ancestral Being.

2. In this paper a practical orthography has been used for Wangkangurru: plosive consonants other than the retroflex plosive have been written as unvoiced (*k, p, th, t*), but prestopped consonants have been written with voiced plosives as this corresponds most closely to the pronunciation, hence *bm, dn, dnh, dnj, dl, dlh*.

Retroflexes have been written as *r*+consonant, i.e.
rl is retroflex *l*
rn is retroflex *n*
rd is retroflex *t*

Interdentals have been written as consonant+*h*, hence *nh, th, lh*.

Palatals have been written as consonant+*j*, hence *tj, nj, lj*.

ng has been used for velar ŋ.

The three r-sounds have been transcribed as follows:
r=the alveolar flap
rr=the trilled r
R=retroflex r.

3. 'L' is L. Hercus, 'M' is M. McLean.

4. The distinction between *wadni* 'ceremony' and *ularaka* 'History' is one of degree of traditional importance: *wadni* was a general term for a ceremony, *ularaka* referred to a man's patrilineal ritual tradition.

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SOUTH AUSTRALIAN ANTHROPOLOGICAL HISTORY: THE BOARD FOR ANTHROPOLOGICAL RESEARCH AND ITS EARLY EXPEDITIONS

P. G. JONES

JONES, P. G. 1987. South Australian anthropological history: the Board for Anthropological Research and its early expeditions. *Rec. S. Aust. Mus.* **20**: 71–92.

This paper concerns the origins and early expeditions of the University of Adelaide-based Board for Anthropological Research. The work of the Board is almost unknown today, yet from its foundation in 1926 the group pioneered the first systematic physical anthropological studies in Australia. The Board undertook annual expeditions to Central Australia until the Second World War, publishing its results in more than a hundred scientific papers. Its members recorded detailed physical data from over 800 Aboriginal people and documented aspects of their lives in some of the earliest ethnographic sound recordings and films to be made in this country.[1]

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ANTHROPOLOGY IN SOUTH AUSTRALIA — HISTORICAL BACKGROUND

A comprehensive history of anthropology in Australia has yet to be written. Most accounts which have appeared (Elkin 1935, 1938, 1939, 1959, 1961, 1970; McCall 1982; R. & C. Berndt 1985; Mulvaney 1964), have concentrated on the beginnings of social anthropology on the eastern seaboard.[2] Fison and Howitt, Brough Smyth, Curr, Roth, Taplin, Mathews, Spencer, Radcliffe Brown and Elkin are some of the names most often quoted. Of this group only Taplin was South Australian-based and his work has been regarded as a provincial echo of Howitt's rather than an original contribution to an evolving local tradition (Taplin 1872, 1873, 1874, 1878, 1879).

While South Australian ethnographers working after 1870 undoubtedly received a good deal of their technique and inspiration from Howitt and his colleagues in Sydney and Melbourne, the growth of South Australian anthropology as a distinct local variant had occurred from the first years of European colonisation. Much of the credit for this should go to South Australia's third Governor, Sir George Grey, himself an ethnographer (Grey 1841a, b). In contrast to the informal studies of Adelaide and Lower Murray Aborigines by George French Angas (Angas 1847a, b), William Cawthorne (Cawthorne 1926) and William Wyatt (Wyatt 1879), the ethnographies prepared in the late 1830s by the Lutheran missionaries C. G. Teichelmann (Teichelmann 1840, Teichelmann & Schurmann 1840), C. W. Schurmann (Schurmann 1844, 1846, Teichelmann & Schurmann 1840) and H. A. E. Meyer (1846) were undertaken either in consultation with Grey or followed his guidelines for orthography (Tindale 1974: 3). Edward John Eyre's detailed account of Lower Murray Aborigines also took account of Grey's influence (Eyre 1845). These ethnographies were in turn used by Taplin in his studies of Ngarrindjeri society and influenced Stirling's contribution to the Horn Expedition report (Stirling 1896).

While this published output of South Australian work helped to promote the emergence of a local tradition of anthropology, a more significant but less measurable influence has been understandably overlooked: the informal discussion and transmission of ideas about ethnography among Adelaide's men of science who were among the immediate precursors of professional anthropologists. The development of the scientific professions in South Australia was particularly characterised by the interplay of linked interests and personalities.[3] With its main university, hospital, library, museum, art gallery, and zoological and botanical gardens sited in close proximity, Adelaide has produced several public figures noted for their eclecticism and involvement in a range of scientific interests.

Edward Stirling, parliamentarian and social reformer, zoologist, medical professor, ethnologist and museum director, is among the best known. His own variant of the prevailing strain of evolutionary anthropology was learnt at Cambridge (Francis Darwin was a close student friend) and was applied most notably during his time as ethnologist with the Horn expedition of 1892, in the company of Baldwin Spencer and Francis Gillen (Stirling 1896).

Anthropological discussion and activity in Adelaide was centred on the Museum and it was Stirling as its Director who set the tone of the South Australian approach to this subject from the 1880s until the end of the First World War. Stirling's professional base was in medicine and his primary ethnographic studies reflected this interest: his study of the Swanport burials became the first substantial Australian publication in physical anthropology

(Stirling 1911). Despite the wide opportunity which he had to develop expertise in social anthropology (his association with significant amateurs in the field such as Francis Gillen and Paul Foelsche preceded Baldwin Spencer's involvement), Stirling showed little interest in the prevailing anthropological issues of the day. Lang's 'Secret of the Totem' (1905), which aroused such controversy among Tylor, Spencer, Fraser, Howitt and their followers, had little impact in Adelaide.

Stirling's main legacy lay not so much in his original contributions to anthropological knowledge and debate as in the stimulus which he gave to interdisciplinary knowledge focusing on Aboriginal studies. Using the Museum as a base he involved other Adelaide medical specialists and practitioners with interests in Australian Aboriginal racial origins and physiology. These were men like Professor R. E. Rennie, Dr William Ramsay Smith [City Coroner and author of 'In Southern Seas' (1924) and 'Myths and Legends of the Australian Aborigines' (1930)], Professor Archibald Watson, Dr A. A. Lendon, Dr W. L. Cleland (father of J. B. Cleland; see Cleland, W. L. 1898, 1900[4]), and later Dr Robert Pulleine, Professor Frederick Wood Jones and Dr Thomas Draper Campbell. All shared an interest in the racial origins, physiology and behaviour of the Aborigines and most contributed significantly to the Museum collections.

After Stirling's death in 1919 his role as the focus for Adelaide anthropology was assumed by Frederic Wood Jones who became the Museum's Curator of Anthropology in that year. Jones showed more enthusiasm for field studies of Aborigines than Stirling and was more systematic in his attempts to obtain information. Between 1921 and 1925 he undertook three field trips to remote parts of South Australia, two in the company of Draper Campbell. These field expeditions foreshadowed the expeditions of the Board for Anthropological Research with their cross-disciplinary interests and the first application of rigorous anthropometric techniques (Jones & Campbell 1924).

The South Australian Museum itself sponsored two major field expeditions during this period. Both the Groote Eylandt expedition of 1921–22 and the Princess Charlotte Bay expedition of 1926 had primarily natural science research objectives but Norman Tindale's presence on each ensured that valuable anthropological data were secured (Tindale 1925–1926, 1928; Hale & Tindale 1933).[5] The Museum Director, Edgar Waite, had the foresight to send Tindale to Melbourne in 1921 to undergo informal training in anthropological techniques from Baldwin Spencer at the National Museum of Victoria.

The Rockefeller Foundation and the Sydney Chair of Anthropology

Both Jones and Campbell published extensively and participated energetically in the international scientific community. Together with J. B. Cleland, they were responsible for the revitalization of South Australian anthropology in the early twenties, leading to the formation in 1926 of the first Anthropological Society in Australia, two years before the New South Wales Society was founded in Sydney. In addition, both the *Transactions of the Royal Society of South Australia* and the *Records of the South Australian Museum* began to include significant ethnographic material at this time. This activity, together with the prestige associated with Stirling's work, helped to make Adelaide a serious contender for the first Australian university Chair of Anthropology in 1926.

The Chair was established primarily as a result of initiatives from the American Rockefeller Foundation, as part of its world-wide effort to strengthen the scientific base of the social sciences. A thorough examination of this policy, its intent and its effects as they related to Britain is contained in Fisher (1980). The impact of the Rockefeller Foundation on Australian anthropology is outlined by Elkin (Elkin 1938, 1939, 1970) and is further discussed by Mulvaney in a forthcoming paper (Mulvaney in press). Contributions to the costs of the Chair came from the Federal government and the six Australian State governments according to their means, but the Foundation supplied the bulk of the funds required: L30,000 over the five-year period 1926–1931 followed by the same amount for 1932–1935 and by L15,000 for the 1936–38 period. While it is quite evident that Sydney was the favoured location both within and outside Australia, Adelaide's claims as a separate centre for anthropological research were considered seriously by the Anthropological Committee of the Rockefeller Foundation to the extent that the city was included in the itinerary of the visiting Rockefeller representatives in December 1925.

It is easy to overstate the significance of personal ties in the emerging history of Australian anthropology, but there is little doubt that Wood Jones' presence in Adelaide gave that city an apparent advantage. This occurred because the Rockefeller Foundation's official responsible for organising the Australian grant was himself a former colleague of Wood Jones. He was the Australian-born anatomist Grafton Elliot Smith with whom Wood Jones had worked in Cairo during 1907–8 on the archaeological survey of Nubia prior to the opening of the Aswan Dam. His contribution to that survey had won Elliot Smith's esteem.[6]

Offsetting this apparent advantage however, was the fact that one of the most influential anthro-

pologists in the world at that time, Bronislaw Malinowski (the evangelist for the Functionalist school and the chief recipient of Rockefeller anthropology money through the London School of Economics), was married to Elsie Masson, daughter of Sydney-based David Masson. Masson was a founding member of the Australian National Research Council which was to administer the Rockefeller grant and he played a large part in the establishment of the Sydney Chair. It is tantalising to reflect on the different complexion which Australian anthropology may have had if Malinowski had married Edward Stirling's daughter Nina as he had intended to do in 1914.

Wood Jones, Cleland and Campbell all apparently believed that Adelaide had a very good chance of securing the first Anthropology Chair in Australia. This was not only because of the current Adelaide work in physical anthropology, but because of the city's historic link with Central Australia and the Northern Territory — the obvious focus for future fieldwork. Moreover, their own experiences among Aboriginal communities had convinced the three men that urgent field work was required and that this was best conducted from Adelaide. They felt strongly that Sydney's geographical advantage lay with the Pacific, not with Central Australia:

> South Australia has been the main centre of the acquisition of knowledge on Central Australia . . . and it seems advisable that Adelaide should continue to hold this leading position, just as Sydney is the recognised centre for the Pacific islands etc.[7]

After visiting Sydney the two Rockefeller representatives — John Embree (a Rockefeller Foundation Director) and Clark Wissler (American Museum of Natural History anthropologist) — came to Adelaide to check on the work being done. By the time of this visit in December 1925 it is apparent that the decision had already been taken to establish the Anthropology Chair in Sydney. Nevertheless, Cleland remained convinced that Adelaide's work could continue independently of Sydney with direct funding from the Rockefeller Foundation:

> If it is decided to make the Adelaide University a base considerable kudos will necessarily attach to the University as a result, great advances will be made in the study of the aboriginal and considerable sums of money will be spent through Adelaide. Every effort should be made to show the advantages offered by this University.[8]

Cleland went to great lengths to ensure that Embree and Wissler were given every opportunity to appreciate Adelaide's resources and advantages. A special committee was established by the Adelaide University Vice-Chancellor to plan for the visit, comprising Cleland, Campbell, Wood Jones, Professor Brailsford Robertson (a son-in-law of Edward Stirling), Pulleine, Edgar Waite (Director of the Museum), Professor Kerr Grant, Professor Harold Davies, and Professor R. W. Chapman.

This committee prepared a whirlwind itinerary commencing immediately after Wissler and Embree's arrival in Adelaide on Sunday, 22 November 1925. In the morning the party visited archaeological camp-sites near Noarlunga and after a picnic lunch drove through the Adelaide Hills to visit Edward Stirling's widow at Mt Lofty. There the visitors inspected Stirling's anthropological library and his photograph collection. The next morning they were shown human biological material in the University Anatomy Museum, followed by a reception at the South Australian Museum and a tour of the collections there. After a tour of the Medical School the group visited three Aboriginal inmates of the Parkside Lunatic Asylum before taking afternoon tea at Stirling's old family home, Urrbrae. In the evening a formal dinner for the visitors was hosted by the University Vice-Chancellor and on Tuesday morning the party set off by rail for the twenty-four hour trip to Wilgena siding, near Tarcoola (see Fig. 1).

This trip was later listed as the Board's first expedition.[9] At a waterhole a few kilometres from the railway line the party met and observed a group of about eighty Aborigines who had recently come in from the north, attracted by the ration depot established at Wilgena. During Wednesday the party photographed the Aborigines, carried out blood grouping tests on 56 Aborigines and observed day and evening ceremonies. On the Thursday they visited the camp again and then drove sixty miles around the station to observe the type of country in which the Aborigines lived. The party returned to Adelaide on the Friday evening.

Following this Rockefeller visit Cleland wrote to Wood Jones (who was visiting England at this time) urging him to return via America and the Rockefeller headquarters in Washington. He believed that the Foundation could be swayed in favour of directly supporting the Adelaide work. Cleland wrote:

> The visit of Dr Clark Wissler and Mr Embree has just ended with an eminently successful result as far as we are concerned. Their views became completely altered after their arrival in Adelaide. Talking to Embree soon after he arrived the impression was clear that they thought that the Rockefeller support should be exercised through the Chair of Anthropology in Sydney. Before they left they admitted that their views had been profoundly modified and that they thought Adelaide was the most suitable centre for the study of the aboriginal, though in Sydney the Chair there might occupy itself with the Pacific problems . . .[10]

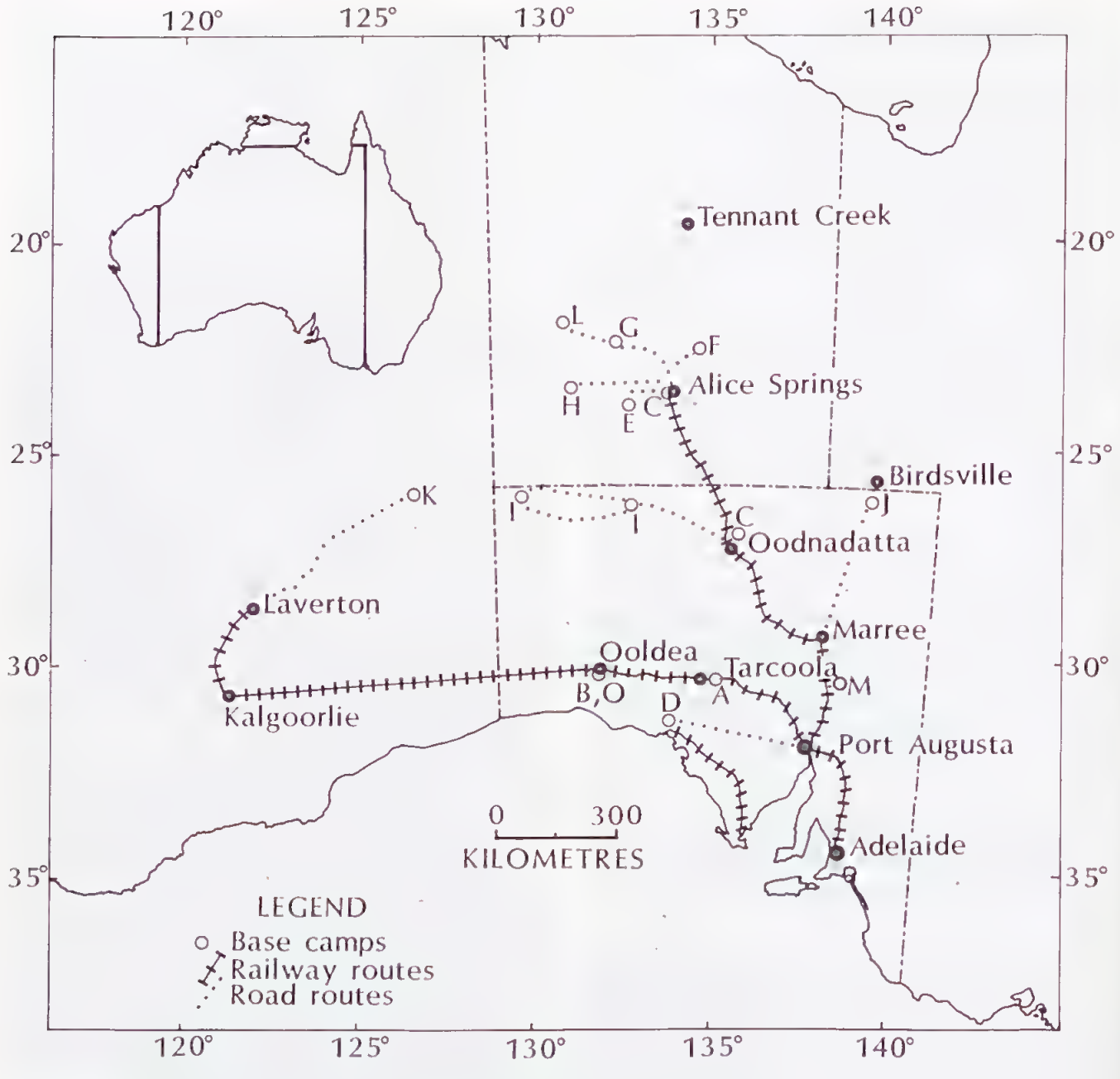

FIGURE 1. Map showing the early expeditions of the Board for Anthropological Research.

A Wilgena, 1925	H Mt Liebig, 1932
B Wilgena, Ooldea, 1926	I Mann Range, Ernabella, 1933
C Macumba, Alice Springs, 1927	J Diamantina, 1934
D Koonibba, 1928	K Warburton Range, 1935
E Hermannsburg, 1929	L Granites, 1936
F MacDonald Downs, 1930	M Nepabunna, 1937
G Cockatoo Creek, 1931	O Ooldea, 1939

Moreover, the Wilgena expedition had shown the Rockefeller representatives how ready the Adelaide workers were to enter the field and to gather important data. As Cleland expressed it:

> Within 24 hours of leaving Adelaide we were in the midst of over 70, probably nearly 90, aboriginals, who, Clark Wissler felt sure, had merely the veneer of civilization, and who were behaving essentially as the wild natives behave . . .[11]

The Establishment of the Board

Buoyed by apparent success, Cleland was keen to maintain the committee and to expand its work into a concerted programme of anthropological research funded by the Rockefeller Foundation. As he wrote to the University of Adelaide Vice-Chancellor:

> It remains now to follow up this big advantage, and Dr Clark Wissler and Mr Embree are very desirous that

> Professor Wood Jones should return to Adelaide via America and discuss more fully the questions at issue. It seems to me important that the work of your committee should not cease at this juncture, but that they should continue preparing plans so as to act, when, as is anticipated, the Rockefeller Foundation will approach the University of Adelaide . . .[12]

Cleland had already contacted members of this committee and other interested individuals in order to construct a research programme. He was prepared to cast the net widely to gain support within the University. Among the written replies came an unidentified response from the Department of Physics, reading in part:

> . . . it is continually impressed upon me as a teacher and examiner in Physics that a very large proportion of the undergraduates of our own race and particularly of those of the female sex, are almost entirely devoid of the power of thinking in abstract or general terms. It would perhaps be of interest to determine whether any aborigines possess this faculty . . .[13]

Other responses were more realistic, emphasising the need for primary research in areas such as Aboriginal song and music (Harold Davies of the Elder Conservatorium) and physical anthropology (Campbell and Wood Jones). The news came in mid 1926 that the Rockefeller Foundation was prepared to support one research centre in Australia only, and that this was to be in Sydney, funded through the Australian National Research Council (ANRC). As Embree wrote:

> Our understanding has been that probably a special committee would be appointed of which possibly the new professor of anthropology at Sydney would be chairman, and that this committee will from time to time determine how funds for research will be expended. Responsibility for such decisions, we feel should rest squarely with the National Research Council or with the special committee. Although definite applications have been made to us for direct support to research at Adelaide, we feel even in that as in other cases that decisions should be made by the group in Australia rather than by us as an outside body.[14]

This attitude to local politics and decision-making characterised the Rockefeller Foundation's philanthropy in Britain and Australia and went some way towards insulating the Foundation against later charges of 'cultural imperialism'.

By the time this decision reached Adelaide, most of the Cleland committee had committed themselves to a research programme and were preparing to begin operations as a Board under the aegis of the University of Adelaide. With local support and the encouragement of Embree and Wissler in the United States, the Adelaide workers were confident that they could exert sufficient pressure on the ANRC for adequate funding of their operations. In addition, Cleland and Wood Jones (later to be replaced by Pulleine) were appointed as South Australian representatives on the ANRC Anthropology Committee. Cleland evidently hoped that this would counter the 'undue Melbourne and Sydney influence' which he considered characterised the ANRC's operations.

By November 1926 Wood Jones had resigned from the University and was due to take up the Rockefeller chair of physical anthropology at the University of Hawaii. One of his last official acts in Adelaide though, was to recommend successfully that the University Council establish the Board for Anthropological Research as a permanent committee of the University.[15] Dr William Ray, Dean of the Department of Medicine and a member of the University Council was nominated as the first Chairman of the new Board for Anthropological Research. The other inaugural members were Professors Wood Jones, Cleland, and Brailsford Robertson, Drs Campbell and Pulleine and Messrs E. W. Holden and E. R. Waite. The first meeting was held on 23 December 1926 with discussion concerning procedural matters and planning for the Board's expedition to Macumba and Alice Springs (Expedition C) which was to depart a week later under Campbell's leadership.[16]

The formation of an effective team of field workers in this short period was partly due to the success of the 1925 Wilgena visit and the resulting encouragement from the Rockefeller Foundation. Disappointment at Sydney's success in securing the Chair and associated funding, and the heightened rivalry which resulted undoubtedly also played a part.[17] A major factor though, was the sense of urgency about the work to be done, based on the assumption that 'traditional' Aboriginal life would disappear during the following decade.

FIGURE 2. Members of Expedition H (Mt Liebig) photographed en route. From left: Hicks, Moore, Holden, Eldridge, Stocker, Gray, Campbell, Tindale, Harvey Johnston, Hale, Fry, Cleland. (SAMA)

The Board's Funding and its Relations with the ANRC

The Board was bound to apply annually for funds to the Anthropology Committee of the Australian National Research Council which itself received an annual grant from the Rockefeller Foundation.[18] This fact ought not to have disadvantaged the Board, particularly as the Rockefeller Foundation had been quite explicit about the style of anthropology which it wished to support:

> . . . the Foundation desires Anthropological research to be carried out in anatomy, archaeology, ethnology, geography, pathology, physiology, psychology and sociology.[19]

Significantly, a study of the Board's expeditions shows that work was carried out in each of these areas, sociology included. Nevertheless, the correspondence between the Board and the ANRC reveals a simmering disagreement over the Board's distinctive approach to fieldwork. Although Wood Jones, Cleland, and later Pulleine were represented on the ANRC's Anthropological Committee, they were rarely able to attend the Sydney meetings to argue their case.

Over the fourteen year period from 1926–40, when the ANRC received L52 500 from the Rockefeller Foundation, the Board was allotted less than L3500. This proportion seems even less generous when it is considered that at the first meeting of the ANRC Committee on Anthropological Research in October 1926, an important criterion for awarding grants was stated as the urgency of salvage research amongst vanishing communities.[20]

The Board's preoccupation with the decline in the Aboriginal population was a major element in its funding applications to the ANRC, and each year a new Board expedition report carried the same message — the urgency of further work 'among our fast disappearing natives'. The popular image of a stone-age culture doomed by contact with a superior civilization was clearly shared by Board members. The 1920s and 1930s saw the continuing rapid decline of the Aboriginal population and Campbell went so far as to construct an equation for it:

> . . . their disappearance is at the rate of 50% per decade of full contact with Europeans. In ten years time [from 1938] there will be few or no, free living natives, and all will be altered by contact with our culture. Free living natives may possess 80 children per 100 adults; in the zone of even spasmodic contact this population drops to 30 per 100, while in the region of continuing contact the proportion may be as low as 3 per 100 in the case of full bloods . . .[21]

There is little doubt that this rate of decline was accurate for the period under discussion and the Board case for special funding support was clearly merited according to the ANRC's own guidelines.

The Board became frustrated with even tighter funding controls after Elkin replaced Radcliffe Brown as Chairman of the ANRC Anthropology Committee in 1931. Elkin clearly took little account of the Rockefeller guidelines for allocating funds, preferring to ignore most of the physical anthropology carried out in Adelaide. His 1935 Presidential address to ANZAAS — 'Anthropology in Australia, past and present') summarised the Adelaide work in two lines.[22] Before granting the Board's funding for 1935, the ANRC demanded a social anthropological report after Expedition J and stipulated that copies of records, films and photographs be lodged with the ANRC.

For its part, the Board responded quickly to suggestions that its grant money from the ANRC was not being well spent, although it properly refrained from comment in July 1934 (after receiving only a quarter of the funding requested for Expedition J) on learning that the ANRC treasurer had misappropriated all of the Council's funds and destroyed the cash books, before committing suicide.[23] In its correspondence with the ANRC, the Board emphasised that its work was undertaken voluntarily and that expeditions sometimes involved considerable personal expense for the members. Herbert Hale (Director of the South Australian Museum) made the additional point that by 1936:

> . . . over fifty publications have already been produced from the fieldwork . . . Comparison may be justly made, for example, with the work carried out under Professor Whitridge Davies, whose expeditions have cost the ANRC almost half the amount allotted to Adelaide, whereas . . . only three publications have resulted so far.[24]

One reaction to the ANRC's parsimony was for the Board to pursue a more direct relationship with the Rockefeller Foundation itself and other American funding sources. Cleland's main contact in this regard was Clark Wissler who had supported the Adelaide work from the outset and suggested in 1931 that the Board might apply directly to the Rockefeller Foundation, thus bypassing the ANRC.[25] Wissler's donation of a motion picture camera after his 1925 visit had made possible the Board's unique series of ethnographic film. He also supported Cleland's scheme for a buffer zone around the central Reserves which might become (in Wissler's words) 'an important step in the establishment of what might be termed an ethnographical laboratory'.[26]

Apart from the blood grouping studies, Wissler was especially interested in the potential for studies

of Aboriginal sexuality and family life, then largely ignored in anthropological work undertaken in Australia.[27] Cleland incorporated these studies within the Board's work, and with special funding arranged by Wissler from Yale University, compiled survey material from a number of personal contacts across the country. These included George Aiston, Daisy Bates, Theodor Strehlow, Ursula McConnel and Reverend John Love as well as lesser known individuals.

The Adelaide work was also supported locally; Sir Joseph Verco, Sir George Murray and Sir Edward Holden (a founding Board member and Managing Director of Holden's Motor Body Works) each contributed substantial amounts. They followed an Adelaide tradition of philanthropy toward anthropology which had begun at the turn of the century with Sir Robert Barr Smith's support of Edward Stirling's work. As well, the Museum was able to fit out most of the expeditions and provided the record cards and other stationery. All of the Board members had keys to the Museum and came and went as staff members, with access to the collections and to secretarial assistance.

Cleland himself was always alert for ways to minimise costs of the Board expeditions. Apart from obtaining railway concessions for the group, he succeeded in arranging donations of soaps and disinfectants, quantities of reject dried fruit, and even cases of wine which were 'very much appreciated. as we were often fatigued by the day's work, which was frequently strenuous'.[28] A small but reliable source of Board income was derived from newspaper articles written about the expeditions by Board members, usually Cleland and Tindale.

The Board's Work — Its Ethos

From the first, the Board consisted predominantly of medical men, drawn mainly from the Anatomy and Pathology Departments of the University of Adelaide's Medical School. This composition reflected a bias which had been operating in Adelaide anthropological circles since Stirling's appointment as honorary Curator of Ethnology at the Museum in 1888, while he lectured at the same time in the Medical School. However there is no doubt that the inaugural members of 1926 saw the Board as much more than an opportunity for armchair anthropology and recreational fieldwork. The scale and intensity of their fieldwork and publishing programme confirms this. And while the Board was not regarded by Sydney and Melbourne anthropologists as contributing satisfactorily to the emerging discipline of social anthropology, it is clear that its members were on the international cutting edge of physical anthropology and were sustained and rewarded by their dialogue with overseas specialists.

Significantly, the pattern for the Board's future work had already been set by Wood Jones and Campbell on their expeditions from 1921 onwards, and particularly by the Wilgena expedition of 1925 [Expedition A] and Campbell's Wilgena and Ooldea trip of May 1926 [Expedition B]. The methods employed on these expeditions were already producing important results, particularly in the area of blood-grouping studies — a special research interest of Cleland. By 1926 it was becoming clear that the Australian Aborigine was distinct from most other populations in lacking blood group B, having only groups A and O.[29] The early expeditions confirmed this. The Board's conclusion, that the Aborigines were a 'pure race' fast disappearing in the face of European culture, reinforced popular opinion in Australia and overseas.

The written responses by University of Adelaide academics to Cleland's 1925 request for 'lines of investigation' (see above, p. 75) cast light on significant aspects of the Board's work. The issues and research questions which initially occupied Board members had little to do with investigating the social relationships, recent history or current views and beliefs of Aboriginal people. In rejecting or ignoring the sophistication of post-Malinowskian fieldwork Board members practised instead what has been termed the 'natural history approach' — recording with meticulous detail 'the more readily observable aspects of culture and biology' (Sutton 1986: 50).[30] Nor was it until Tindale, Fry and Strehlow began to exert an influence on the Board's activities that serious efforts were made to appreciate the complexity of Aboriginal social structure and belief systems. Cleland's own proposed 'lines of investigation' contained a minor exception in his final suggestion:

> 13. [The] Collection of [kinship] terms and their analysis and consideration.[31]

Generally, most of the responses indicated that Aborigines were perceived as the passive objects of scientific enquiry, providing a plethora of new data for diverse fields of research. Harold Davies' interest in ascertaining Aboriginal knowledge of the pentatonic scale in Aboriginal song, R. W. Chapman's (Department of Engineering) enquiry into whether Aborigines used the lever, wedge, roller or other simple machines, Campbell's investigations of habits and customs 'in vicinities where natives have suffered minimum contamination' revealed a similar outlook, founded in the same ethno-centrism which had characterised ethnography during the previous century. The process of measuring and recording

Aboriginal physical and social characteristics occurred within the overarching framework of evolutionary theory and should be seen against the contemporary background of debate over the heredity versus environment issue. Wood Jones himself was an active contributor to this debate and as a self-professsed Lamarckian evolutionist stressed the need to understand the total environment within which Aborigines lived.[32]

The Board produced no explicit published statement of its aims and objectives during its early years; its credo is best discerned from individual reports and correspondence. Campbell gave it cogent expression in a 1931 letter to the Honorary Secretary of the ANRC:

> The trend which the University is aiming at in these studies is not merely a compilation of statistics for assessing the Australian natives' comparative physical status, but rather an attack on the more practical problem of how he adapts himself to his environment . . .

and again in 1932:

> The aim now is to include as much, as is reasonably possible, data which will enlighten us not only on the native himself but his surroundings and his reactions to his biological, physiographical and meteorological environments . . .[33]

There is strong circumstantial evidence to suggest that this statement of aims was inspired by, if not derived directly from, the contact which the Adelaide workers had with their American benefactors, Clark Wissler in particular. Wissler, a pupil of Franz Boas, had developed his own model of culture/ecological areas for North America (Wissler 1926) based on similar principles. His colleague, Alfred Kroeber, developed this theme further in his classic 1939 study 'Cultural and natural areas of North America' proposing that:

> . . . no culture is wholly intelligible without reference to the noncultural or so-called environmental factors with which it is in relation and which condition it.[34]

The Board's activities and publications stressed this conjunction between Aborigines and their environment and so highlighted a major point of difference between Sydney and Adelaide anthropology. The social anthropology promoted by Radcliffe Brown and later by Elkin was concerned with the internal functioning of small-scale Aboriginal (and Pacific) societies, focusing primarily on social relations and local processes of acculturation. This approach left little room for analysing or even taking account of broad evolutionary changes, long term adaptations to the environment, or diffusion of culture traits throughout Australia by Aborigines — issues which preoccupied the Adelaide workers. The ANRC's refusal to fund an investigation by Cleland and Stanton Hicks into the pharmacological properties of the plants *Nicotiana* and *Duboisia* in 1932 illustrates this basic difference in outlook. The ANRC regarded such work as beyond the proper ambit of anthropological investigation, bringing a firm response from Cleland. Regional bias against Adelaide must have been apparent when, in the following year, the ANRC granted funds without demur to a Melbourne researcher for an investigation of the biochemical characters of Aboriginal foods.[35]

Despite the fact that most Board members made substantial contributions in their own University fields, the Board's anthropological work reflected a wide range of shared interests and knowledge. Cleland is probably the outstanding example of this type of worker. No dilettante, his significant publications in the fields of pathology, ornithology, botany, and Aboriginal studies represented a remarkable understanding of the Australian natural and social environment. It is likely that Cleland's own eclecticism inspired Board members to develop new interests and skills. Other Adelaide scientists were also influential. Norman Tindale recalls how Charles Fenner:

> . . . encouraged all researchers to look at things from a geographer's point of view . . . he and Grenfell Price, who was another geographer . . . had a great influence here.[36]

It was probably the example of these two men which led Cleland and Professor Harvey Johnston to meticulously correlate geographical and botanical features during the expeditions. Tindale recalls travelling through desert country on several trips, making botanical and topographical observations for every mile of the journey from a railway carriage or the Board's vehicle.[37]

Other Board members displayed the same enthusiasm for new fields of knowledge. Tindale, who had already made the transition from entomology to ethnography, moved further into the field of social anthropology and embarked on his major work of mapping the distribution of Aboriginal tribal groups. His much-criticised 1940 study of the social and demographic issues surrounding the 'half-caste problem' was nevertheless the first survey of its kind. H. K. Fry — a Rhodes Scholar and the first Oxford-trained Australian anthropologist — married this training with his chosen profession of psychology to produce an original schema for analysing kinship relationships in Aboriginal societies. Thomas Draper Campbell, later the Foundation Professor of the Adelaide School of Dentistry, became widely known for his studies of stone tool typologies as well as his work on Aboriginal dentition and diet.

Cleland particularly, and the Board by extension, may be criticised for the stress which they laid on policies considered unpopular today — segregation and assimilation. Cleland's interest and participation in the amalgam of issues known collectively at the time as 'the native question' dated from his early interest in Aboriginal health and disease. His own experience of the rapid decline in 'full-blood' population led him to support the total assimilation of part-Aboriginal people into the European population. On the other hand, he urged the extension of the Central Australian reserves to shield the remaining 'bush' Aborigines from European influence. This later scheme becam an *idée fixe* during the 1930s and Cleland even attempted to have the University of Adelaide Council purchase a lease on land abutting one of the reserves as a 'buffer zone'. The University's involvement would, according to Cleland, be:

> . . . in the interests of the native . . . afford better opportunities for the study of them . . . and [would] ensure their protection for many generations to come . . .[38]

Despite Wissler's support for this notion of an 'ethnographical laboratory' the Council considered that it could not 'appropriately be considered amongst the activities of the University'.[39]

This utopian scheme was in direct contrast to the Board's usual pragmatic approach to Aboriginal issues, and to health problems in particular. Their involvement with medical issues and problems on expeditions was routine but led to some outstanding successes. The Board's fortuitous arrival at Hermannsburg in August 1929 at the height of an outbreak of scurvy, and their prompt action in eradicating the illness, earnt the lasting gratitude of both Aborigines and missionaries. It also led to the Board's support of the public campaign to have fresh water piped to Hermannsburg and to the appointment of the first medical officer in Central Australia with responsibility for Aboriginal health.[40]

Finally, the Board considered that it had clear jurisdiction over anthropological work conducted within South Australia — and at least a consultative role regarding Central Australia. This was not only through its own research, but through its support of fieldworkers such as R. & C. Berndt, C. P. Mountford, Strehlow, Love, Daisy Bates, and Olive Pink. Cleland was particularly supportive of Strehlow's Central Australian fieldwork in his dealings with the ANRC and he consequently resented that body's practice of sending fieldworkers to South Australia without consulting the Board. Matters came to a head in 1943, when Cleland wrote to Elkin, saying:

> Dr Campbell and myself would recommend strongly that the Board for Anthropological Research of the University of Adelaide should be recognised officially by your Committee on Anthropology and consulted on all matters affecting anthropological research in South Australia.[41]

The Sydney and Melbourne versus Adelaide rivalry, which had affected the course of Australian anthropology since Stirling's time, had still to run its course.

The Board's Work — Its *Modus Operandi*

The *modus operandi* of the Board's fieldwork — the 'teamwork' approach — provided another point of difference with the Sydney anthropologists. This method involved several researchers with clearly defined specialties working intensively among an Aboriginal group for two to three weeks. The teamwork approach seems to have been pushed hardest by Wood Jones who saw it as the optimum method. He may have been influenced by the immense productivity and pioneering methods of the multidisciplinary expedition led by Alfred Cort Haddon to Torres Strait in 1898.

This approach to anthropological fieldwork was heavily resisted by the ANRC. It stressed the need for long-term 'participant observation' following the Malinowskian model, and regarded this method as a prerequisite for gathering social anthropological data of any value. The Council attempted to influence the Board on several occasions to conduct 'longer field trips with a smaller personnel'. Campbell's response to this suggestion (and to the insinuation that funding would consequently be easier to obtain) was unequivocal:

> . . . if the particular programme of work being carried out here were not carried out along the lines adopted, it is doubtful whether this type of research, which is urgently needed, would be carried out at all . . . The team of workers consists of men who, in most cases, are specialised in their own particular line of research . . . This combination of special training and continuity of field experience in a particular line, applied in an intensive manner, counterbalances to a very large extent what might seem to be the disadvantages of short working periods . . . The larger team permits of a large group of natives being examined in a fairly short time. These large groups of natives cannot be held together for any lengthy period without serious difficulties and considerable expenditure on rations,[42]

The only exception to the early 'teamwork' expeditions was the first part of Expedition I (May–July, 1933), in which Tindale and Hackett travelled with a group of Pitjantjatjara Aborigines through the Musgrave Ranges for two months, carrying equipment and supplies by camel and

having only occasional contact with outside support. This was a markedly different experience for both men as for once they were entirely dependent on the Aborigines they had come to study. As Tindale comments:

> Cecil and I became just kind of hangers-on or parasites of the Aborigines, just wandering along, taking photographs and asking questions, recording . . .[43]

The expeditions required detailed planning and this was usually Campbell's task. Expedition destinations were discussed at the Board meetings (held irregularly as circumstances warranted) and the decision was usually dictated by the available finances and the accessibility of centres of Aboriginal population. Personal contacts also played a part — the Chalmers family of MacDonald Downs Station influenced the decision for the 1930 expedition, Strehlow arranged for a remote Pintupi group to be present at Mt Liebig (1933), Lew Reese assisted the 1934 Diamantina arrangements, and Cleland's cousin, W. L. Cleland, arranged the cooperation of Maitland Brockman of White Cliffs Station, north-east of Laverton, for the 1935 Warburton Range expedition. This 1935 trip took the Board to their most remote destination and Brockman's assistance was important in the organisation. He wrote to the Board:

> I am on the outskirts of settled pastoral country . . . & see a number of full blood blacks . . . there are no crosses, & as they are yet in their naked state they will be what you are looking for . . . [and in answer to Cleland's request for a budget estimate] Cost of feeding them for 10 days — 40 blacks, flour meat tea sugar tobacco @ 1/6 per hd. per day for bucks. 1/ — gins & 6 children . . . say 40 @ 1/ per day . . .[44]

The expeditions were generally organised during the University of Adelaide's August vacation which allowed sufficient time in the field and usually also meant favourable camping conditions in Central Australia. As the map shows (Fig. 1), the first part of each expedition was completed by rail. This was an expensive component (up to a third) of expedition costs and Campbell and Cleland worked hard at obtaining rail concessions and reserved carriages for the group.[45]

Once at the railhead, the party transferred to motor transport, arranged in advance, for the final leg. Throughout the period the trucks and cars used on the expeditions stood the strain of up to eight men, supplies and heavy medical equipment without any serious hitches. More importantly, on arrival at their destinations the parties always found the expected number of Aborigines. As Cleland confided to Elkin before the Warburton Range expedition of 1935:

> These expeditions are always somewhat of a lottery, as in spite of the best of plans the natives may not be where you want them . . .[46]

This was more likely to happen towards the end of an expedition, when the novelty had worn off and the food supplies brought by the party were getting low.[47] After the Mt Liebig expedition of 1933 (H), Cleland wrote: '. . . it seems quite impossible to hold for a longer period than about a fortnight any large congregation of natives . . .'[48]

A regular protocol for the Board's work was well established by the time of the 1933 Ernabella expedition (I) and was documented by Cleland in his expedition report (1934). Each Aborigine was first given a number, and Tindale entered his or her name, approximate age, genealogical and totemic data on a card, noting other relevant sociological information. With their numbers painted on their shoulders, the subjects moved on to the physical anthropologists (Hackett and Gray) who took 53 body measurements and noted features of skin and eye colour, scarification, pathological lesions, and condition of the teeth. Hale then took still photographs of each Aboriginal subject before passing them to Cleland and Harvey Johnston for blood-grouping tests, finger-printing and dermatoglyphs. The pair also obtained names of plants and animals and related data. Hicks and O'Connor carried out intensive metabolic tests and cardio-vascular examinations on a sample of twenty-four Aborigines and Hale and Tindale obtained plaster of paris face and bust casts of six individuals. After limited success with his Porteus maze and other psychological and sensory tests, Fry concentrated instead on obtaining vocabularies, and studying 'customs, beliefs, games and technology' as well as eliciting the kinship system. Apart from the number of photographs taken by expedition members, Stocker took a large amount of 16 mm film which was later edited to comprise 2575 feet, dealing with ceremony, sign language, hunting, games, artefact manufacture, walking and running gaits, and incidents from daily life.[49]

The basic procedure remained the same on all of the early Board expeditions, although details varied according to the personnel. The physical measurements were based initially on those recommended by the Geneva International Agreement of 1912 for observations on living subjects, and on Hrdlicka's work (1920). A full list of the tests carried out on Expediton F (MacDonald Downs) is contained in Appendix 1.

Aboriginal Perceptions of the Board

Initially at least, the spectacle of the university researchers arriving by motor lorry with their

FIGURE 3. Measuring and weighing Aboriginal people on Expedition C (Macumba–Alice Springs). (SAMA)

FIGURE 4. Jeffrey discussing photographic poses with an Aboriginal man on Expedition C (Macumba–Alice Springs). (SAMA)

outlandish equipment and even stranger behaviour appears to have been amply sufficient to keep large numbers of Aborigines diverted for several days. The pace of the work programme ensured this, if nothing else.

The question of how Aborigines regarded the bizarre activities of Board members on these expeditions merits a study in itself. Unfortunately little work has been done on eliciting memories of these expeditions from Aboriginal people. Linda

FIGURE 5. Measuring lung capacity on Expedition C (Macumba–Alice Springs). (SAMA)

FIGURE 6. Stocker filming Aboriginal men on Expedition H (Mt Liebig). (SAMA)

Crombie is one exception — she was seven at the time of the 1934 Diamantina expedition and recalls refusing to remove her shirt for a still photograph. The newspaper reporter who accompanied Expedition H (Mt Liebig) made his own enquiries through an interpreter and was told that:

> . . . they could not understand why the white men came all this way to ask them so many questions, smear white stuff over them, and stick prickles in their ears . . . The natives said they did not mind the indignities because they were good men, although 'quite silly' and what was important, they brought good tucker for the black men . . . They think the white man does a lot of things because he wants to help the black man. They think Prof. Hicks oxygen tests will help a man with weak wind to run up hills as easily as a strong man.[50]

Certainly, on the first expeditions, Cleland was apprehensive of the reaction from Aborigines when conducting blood grouping tests. On the 1927 Macumba–Alice Springs expedition he used an original strategy:

> We explained to them in pigeon [*sic*] English that we wanted to see whether the blackfellow's blood was more like the white man's than that of a Chinaman or an Afghan, and they all assented by nods to our request for obtaining samples of blood.[51]

Later, on the 1929 Hermannsburg expedition, Cleland and Johnston:

> . . . soon gained the sobriquet of 'the butchers' from the surrounding aborigines, and our mild form of operation was designated, in cattle terms, as 'ear-marking.' It soon became the fashion to be ear-marked, and those who had it not eagerly desired it. As we were not dealing with half-castes, some of these were bitterly disappointed at our refusal to bleed them.[52]

In their reports and personal reminiscences both Cleland and Tindale stress this aspect — that far from being intimidated or having to be bribed or cajoled into participating, most Aborigines actively entered into the spirit of the procedure. After the inevitable shyness of the first day:

> . . . the utmost willingness was always manifested and any individual accidentally left out temporarily from some part of the routine would either himself, or by one of his fellows, call attention to the omission.[53]

This certainly surprised some members of the expeditions, who expected resistance to blood sampling tests at the least. Cleland remarked several times on the stoicism displayed by Aborigines while undergoing face casting and metabolic testing under extreme conditions. A can of pineapple became the standard exchange for the gruelling face cast procedure and other small inducements were given, like cigarettes and boiled sweets. These were more in the nature of a reward than a bribe or payment.

Most of the Aboriginal people involved in these early expeditions had had very little experience of European technology and machinery. The Board's array of motor vehicles, electricity generators, x-ray equipment, vasometers, cardiometers, gramophones and motion picture cameras must surely have exceeded the impact of a full-scale circus on a country town. Tindale probably comes closest to explaining the Aboriginal view:

> . . . in a sense, we entertained them. Our activities were so strange to them . . . I don't think that the bush ones in the early days ever realised that we were making records of them. They had no idea why white men held boxes up to their eyes when they were talking or asking questions, or looking at ceremonies. That was their [the white men's] *inma*, their ceremonial way of doing it.[54]

This view may have been heightened by the expedition members' practice of beginning the day's routine by playing the Aboriginal song recordings made by Harold Davies at Koonibba in 1926 (Fig. 7), interspersed with popular songs and some Japanese gramophone records which Tindale had acquired from his childhood in that country:

> We'd play them first thing in the morning when we were ready to start work and the first Aborigine would appear and the rest of the day there would be Aborigines winding up the machine and putting the records on and keeping it going. Some of the records more or less wore down, almost through . . .[55]

FIGURE 7. Aboriginal men listening to the 'Radiola' on Expedition H (Mt Liebig). (SAMA)

FIGURE 8. Pulleine obtaining crayon drawings on Expedition I at Ernabella in August 1933. (SAMA)

Despite the brevity of these expeditions, the Aboriginal people classified the visitors within their kinship systems, assigning terms and personal names to each member of the expedition party. The coincidence of the number of members on Expedition E (Hermannsburg) with the eight Aranda subsections provides a striking example of this social incorporation:

FIGURE 9. Wilkinson obtaining dermatoglyphs on Expedition I (Ernabella). (SAMA)

> One of the natives made this discovery, with the result that we were immediately allocated in all seriousness each to one division and accepted as full members of the tribe. A plenitude of tribal relatives sprang up — parents, uncles and aunts, brothers and sisters were in embarrassing profusion, and most cordial relationships existed, facilitating greatly the enquiries on which we were engaged.[56]

Conclusion

The last of the 'teamwork' expeditions — to Ooldea in August 1939 — closed an era in Australian physical anthropology. Later Board expeditions concentrated more closely on discrete aspects of Aboriginal life and behaviour and did not attempt to duplicate the ambitious research programmes of the early years. Although physical anthropological studies remained as a basis for Adelaide anthropology until the University of Adelaide established its Department of Anthropology in 1974, the central relevance of these studies, and related issues of racial origins and characteristics, had greatly lessened in the meantime. Discussion and theory about Australian Aborigines increasingly centred on social and religious life; without a formal commitment to research of this kind, Adelaide's importance as a centre for anthropology after World War 11 was steadily overtaken by other Australian capitals.

A later paper will discuss the 1938–39 Australia-wide expedition mounted by the Harvard and Adelaide Universities, as well as the Board's post war activities, culminating in the establishment of the Adelaide Chair of Anthropology.

Endnotes

Abbreviations:

ANL — Australian National Library.
SAMA — South Australian Museum Archives.
UAA — University of Adelaide Archives.

1. Professor Norman Tindale, Dr Cecil Hackett and Professor John Mulvaney all gave me valuable assistance with this paper. I would also like to thank the staff of the Mitchell Library and the Barr Smith Library Special Collections for their assistance, and Kathy Bowshall for drawing the map.

2. In a paper to be published in 1988 (Mulvaney in press), Mulvaney goes some way toward correcting this bias by devoting a section of his discussion to Adelaide anthropology.

3. See Twidale *et al.* (1986).

4. Cleland stressed the requirements of physical anthropological research in his 1899 address to the Royal Society (Cleland 1899).

5. Hale and Tindale's 1925 expedition to work among Aborigines of the Flinders Ranges should also be mentioned — see Hale & Tindale (1925).

6. Australian Dictionary of Biography 9: 510. See Elkin & Macintosh (1974) for biographical essays on Elliot Smith and assessments of his contribution to theories of evolution and cultural diffusion.

7. Cleland to Gibson 31.7.36 — ANL Ms. 482, Box 32, Folder 498.

8. Cleland, J. B. 1925 (attributed) 'Memo re Visit of Representatives of the Rockefeller Institute, in reference to the Endowment of Research in the Anthropology of the Australian Aboriginal'. SAMA, AA 60, Acc 243.

9. The sequence of Board expeditions, their dates and destinations is provided in Fig. 1 and Appendix 2. Campbell and Wood Jones' 1924 expedition to Mt Eba and Streaky Bay has also been referred to as Expedition A in the Board's records, but it clearly did not come within the Board's own chronology (Jones & Campbell 1924).

10. Cleland to Wood Jones, 1.12.25, SAMA, AA 60, Acc 243.

11. *Ibid.*

12. Cleland to Vice-Chancellor, 2.12.25, SAMA, AA 60, Acc 243.

13. Copy of letter to Cleland dated 19.11.25. SAMA, AA 60, Acc 243.

14. Embree to Masson, 27.5.1926, ANL Ms. 482 Box 61, Folder 853b. Notice of this decision was sent to Wood Jones and the University of Adelaide. Details are contained in Docket 77/26, UAA.

15. University Council Minutes, 10.12.26, UAA.

16. Expedition B, under the leadership of Campbell, had visited Wilgena and Ooldea in May 1926. For the Minutes of Board meetings see Board Minute Books, UAA.

17. Philip Jones-Norman Tindale interview, 3.1.85.

18. See Mulvaney (in press) for a description of the funding relationship between the ANRC and the Rockefeller Foundation.

19. ANL Ms. 482 Box 61, Folder 853b and see Embree to Masson, 27.5.26 (two letters) — ANL Ms. 482, Box 61, Folder 853c.

20. ANL Ms. 482, Box 62, Folder 862.

21. Tindale to Keppel, 20.10.38. UAA, Cleland Papers, 572 SR Box 1, Folder 1.

22. Elkin 1935: 202. Elkin's dismissive attitude toward the Board's work is evident throughout his other surveys of Australian anthropology.

23. Elkin to Cleland, 8.6.34. SAMA, AA 60, Acc 247.

24. Hale to Gibson, 5.5.36. ANL Ms. 482 Box 32, Folder 498.

25. Wissler to Cleland, 6.2.31, SAMA, AA 60, Acc 244. American interest in the Adelaide work was enduring, as Tindale's success in obtaining backing for the later Harvard-Adelaide and UCLA-Adelaide expeditions shows.

26. Cleland to Gibson, 20.6.33, ANL Ms. 482, Box 32, Folder 498.

27. Wissler to Cleland, 11.6.28, SAMA, AA 60, Acc 244:
> The point of view in such studies would be to secure data on all the phases of primitive sex life that parallel those under investigation among ourselves . . .

28. Cleland to Fulton, 4.9.31, writing after Expedition G (Cockatoo Creek). SAMA, AA 60, Acc 240.

29. See for example, Cleland to Elkin, 9.11.1934, SAMA, AA 60, Acc 247:
> In blood grouping we again got only A's and O's. The importance of this work in showing that the Australian native is pure blooded is, I think, great.

30. At the same time, it is worth noting that this positivist faith in 'objective' data was also shared by social anthropologists of the period, particularly by Radcliffe-Brown. Urry (1984) discusses these issues. See also Chase & von Sturmer (1973).

31. Cleland 'Lines of investigation'. SAMA, AA 60, Acc 243.

32. Australian Dictionary of Biography 9: 511. It is worth noting that Elliot Smith was also a Lamarckian. Both he and Wood Jones were known for their eccentric belief that man had evolved from the tree-dwelling tarsioid, through its Lamarckian urge to self-betterment. See Wood Jones (1916) and Hooton's playful demolition in Hooton 1938: 63–67.

33. Campbell to Hon. Sec., ANRC, 2. 10.1931; Campbell to Hon. Sec., ANRC, 10.2.1932. ANL Ms. 482, Box 60, Folder 848a.

34. Kroeber (1939: 205).

35. Cleland to Firth, 24.10.1932; Cleland to Elkin, 31.5.1932, SAMA, AA 60, Acc 247.

36. Philip Jones-Norman Tindale interview, 3.1.85.

37. See for example Cleland 1936: 114.

38. Memorandum to the Council of the University of Adelaide, 24.10.32. SAMA, AA 60, Acc 240. See also Cleland to Minister for the Interior, 7.9.36, SAMA, AA 60, Acc 2440.

39. Eardley to Cleland, 12.12.32, SAMA, AA 60, Acc 240.

40. Albrecht wrote in his 1930 annual report:
> If it would not have been for the Doctors of the Adelaide University Expedition who came here engaged in Anthropological research work, the majority of our native community would probably have died out . . . (SAMA, AA 60, Acc 247).

41. Cleland to Elkin, 30.1.83. SAMA, AA 60, Acc 247.

42. Campbell to Hon. Sec., ANRC, 28.6.32, ANL Ms. 482, Box 60, Folder 848a.

43. Philip Jones-Norman Tindale interview, 3.1.85. Hackett also recalls how the experience:
> . . . of living among the stone-age, gatherer-hunter Pitjantjatjara in conditions where they were the majority and privileged, and we were the minority and under-privileged, made a lasting and humbling impression on me . . .

(Hackett 1978: 15).

44. Brockman to Cleland, 13.3.35, SAMA, AA 60, Acc 240. Campbell, who had the job of organising the trip, commented to Cleland on Brockman's reply:
> . . . similar to most of the replies from these outback chaps. Earnest, helpful, friendly, but failing to give answers to specific and (to me) important queries (Campbell to Cleland, 18.3.35, SAMA, AA 60, Acc 240).

45. 'We much appreciate the reserving of carriages and travelling most comfortably . . .' Cleland to Railways Dept, 29.8.33, and see Cleland to Minister for Railways, 24.1.34 for a record of the Board's x-ray equipment being transported without charge over South Australian railways. SAMA, AA 60, Acc 240.

46. Cleland to Elkin, 31.7.35 SAMA, AA 60, Acc 247.

47. Cleland gives this description of the menu during the Mt Liebig expedition:

> They were fed abundantly morning and evening . . . on heavy damper, boiled wheat (which they liked very much), buck currants (also very much relished), tea and sugar. They soon noticed the absence of meat, and so from time to time sent out their young men or the women, the first to spear wallabies and the latter to dig out rabbits. On Sunday they were given a half holiday, being fed only in the morning . . .

(Cleland 1934: 849).

48. Cleland (1934: 849).

49. See Cleland (1934) for a fuller description of these activities.

50. *The Mail*, 13.8.32, SAMA, AA 298, Acc 2375. As to why Aborigines might have developed such a theory, see Hicks 1964: 405:

> . . . a very experienced white bushman advised us . . . we should let it be known that what we were doing would strengthen the chests of the participants, 'make good wind'.

51. Cleland (1927: 78).

52. Cleland (1930: 80).

53. Cleland (1934: 849).

54. Philip Jones–Norman Tindale interview, 3.1.85. See also Hicks 1964: 405:

> . . . a very experienced white bushman . . advised us to enhance the importance of ourselves and our experiments by restricting our measurements to the male. Thus, the early morning procedure became, as it were, a secret corroboree or totem affair.

55. *Ibid.*

56. Cleland (1930: 80). The coincidence also inspired Fry to work on developing his own method of kin term classification — the 'Fry Framework' (e.g. Fry: 1931).

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APPENDIX 1: CLELAND'S SUMMARY OF THE BOARD'S WORK ON EXPEDITION F (MACDONALD DOWNS)

In his expedition report to the ANRC (SAMA AA60, Acc.240), Cleland wrote:

> 'The work carried out may be grouped under the following headings:
>
> **1. Physical anthropology**
>
> (a) Forty-five measurements of the various parts of the body, including twenty-five of the head and face
> (b) Profiles
> (c) Dermatoglyphs and finger prints
> (d) Hair tracts and characters and body distribution of hair
> (e) Body pigmentation, including the oral cavity matched against standard
> (f) Complete examination of the teeth
> (g) Blood grouping (59 individuals) and cross testing of the native red cells in serum
> (h) Casts of the hand, feet and face
> (i) General bodily build and other characters of eye, ear, lips, nose, etc.
> (j) Photographs of profile and full face, head and bust.

2. Physiological and psychological observations

(a) Pulse, temperature and blood-pressure observations
(b) Strength of grip, strength of pull, measurement of sustained grip
(c) Sense estimations, such as visual acuity, range of audition and hearing tests, olfactory senses, tactile sensation, and aesthesiometer
(d) Pressure, pain and temperature discrimination
(e) Discrimination of weights
(f) Discrimination of numbers and spatial perception
(g) Muscle co-ordination, such as peg-board, tapping test
(h) Reaction-times to sight and sound
(i) Mental tests, memory tests with blots and foot impressions. Porteous maze, Goddard and Henley puzzles
(j) Native drawings with crayons on paper comprising (i) portrayal of natural subjects such as kangaroo, emu, man, *Varanus*, etc. and (ii) totem representations.

3. Ethnology

(a) Individual data as to name, age, blood relations, marriage class and totem, and genealogy
(b) Phonographic records of native songs and 20 standard words
(c) Photographic records of ceremonies and daily life, including grain collecting, digging for lizards, and collecting and preparation of food.'

APPENDIX 2: DETAILS AND RESULTS OF BOARD EXPEDITIONS A-M, O

N.B. Expedition records and most photographs are in S.A. Museum unless otherwise specified. Master copies of 16 mm films are held in the Barr Smith Library, University of Adelaide. Publication numbers refer to the bibliography of Board expeditions in Appendix 3.

Abbreviations: SLSA — State Library of South Australia.
AIAS — Australian Institute of Aboriginal Studies.

Expedition A: Wilgena, 24.11.25-27.11.25
Personnel: J. B. Cleland, T. D. Campbell, T. B. Robertson, R. H. Pulleine, E. Embree, C. Wissler
Investigative expedition only. Film records believed to exist in Rockefeller files.
Photographs: *c.* 90 general views
Publication: 2

Expedition B: Wilgena and Ooldea, 7.5.26-21.5.26
Personnel: T. D. Campbell (physical anthropology, blood grouping, dentistry) and F. Wood Jones (physical anthropology, blood grouping)
Record cards and photographs: 32 individuals
Other photographs: *c.* 100
Publications: 1, 3

Expedition C: Macumba, Alice Springs, 30.12.26-19.1.27
Personnel: T. D. Campbell, C. J. Hackett (physical anthropology), W. Ray (physiology and pathology), J. B. Cleland (blood grouping, pathology, botanical work), E. H. Davies (songs and music), F. Jeffrey (photographer), E. W. Holden (transport, climatological records, assistant to physical anthropology)
Record cards and photographs: 64 individuals
Other photographs: *c.* 300
Sound recordings: 17 wax cylinders-E. H. Davies (AIAS tapes 9567, 9569, 9570, 9580)
Publications: 4-10, 69, 76, 105

Expedition D: Koonibba, 13.8.28-25.8.28
Personnel: T. D. Campbell, C. S. Hicks (physiology, basal metabolism), E. Eldridge (Hicks' assistant, technician) R. F. Matters (basal metabolism), M. L. Mitchell (physiology), N. B. Tindale (ethnology, photography), R. H. Pulleine (physiology), H. H. Woollard (blood grouping), F. Jeffery
Record cards and photographs: 52 individuals
Other photographs: *c.* 250
Sound recordings: 22 wax cylinders-E. H. Davies (AIAS tapes 9564, 9565, 9580)
Artefacts: *c.* 45
Publications: 11-14, 69, 105, 118, 123

Expedition E: Hermannsburg, 4.8.29 -23.8.29
Personnel: J. B. Cleland, C. S. Hicks, E. H. Davies, N. B. Tindale, C. J. Hackett, B. G. Maegraith (blood grouping), H. K. Fry (psychology, sociology), H. M. Hale (photography, plaster casts)
Record cards and photographs: 100 individuals
Other photographs: *c.* 200
Sound recordings: 34 wax cylinders-E. H. Davies (AIAS tapes 9570, 9571, 9572, 9580)
Artefacts: *c.* 60
Publications: 15-20, 48, 65, 69, 76, 82, 105, 115, 118, 123

Expedition F: MacDonald Downs, 17.8.30-11.9.30
Personnel: J. B. Cleland, T. D. Campbell, H. K. Fry, R. H. Pulleine, H. M Hale, N. B. Tindale, T. Harvey Johnston (assisted Cleland, botany, zoology), H. J. Wilkinson (dermatoglyphs), J. H. Gray (physical anthropology, pathology)
Record cards and photographs: 62 individuals
Other photographs: *c.* 200
Face casts: 14
Sound recordings: 13 wax cylinders-N. B. Tindale (AIAS tapes 9566, 9567, 9574)
16 mm film: 2 reels (800 ft-T. D. Campbell and N. B. Tindale)
Crayon drawings: 20 sheets
Artefacts: *c.* 180
Publications: 22-27, 32, 47, 68, 79, 105, 123

Expedition G: Cockatoo Creek, 6.8.31-27.8.31
Personnel: J. B. Cleland, T. D. Campbell, H. J. Wilkinson, J. H. Gray, C. S. Hicks, T. Harvey Johnston, H. K. Fry, R. H. Pulleine, N. B. Tindale, E. O. Stocker (cinematography), A. Rau (Museum taxidermist)
Record cards and photographs: 91 individuals
Other photographs: *c.* 200
Face and bust casts: 20
Sound recordings: 13 wax cylinders-N. B. Tindale (AIAS tape 9572)
16 mm film: 6 reels (2150 ft-E. O. Stocker)
Crayon drawings: 19 sheets
Artefacts: *c.* 240

Publications: 28–31, 33–37, 47, 48, 50, 69, 91, 99, 100, 105, 117, 118, 123

Expedition H: Mt Liebig, 4.8.32–25.8.32
Personnel: J. B. Cleland, T. Harvey Johnston, C. S. Hicks, E.Eldridge, T.D. Campbell, J.H. Gray, H.K. Fry, H. M. Hale, N. B. Tindale, E. O. Stocker, E. W. Holden, H. Moore (gas analyses for physiological tests), T. G. Strehlow (linguistics), M. Lamshed ('Advertiser' reporter)
Record cards and photographs: 93 individuals
Other photographs: *c.* 400
Face and bust casts: 8
Sound recordings: 6 wax cylinders–T. D. Campbell and N. B. Tindale (AIAS tapes 9564, 9574)
16 mm film: 8 reels (3080 ft–E. O. Stocker)
Crayon drawings: 19 sheets
Artefacts: *c.* 320
Publications: 38–40, 42, 43, 45–47, 50, 52, 55–57, 69, 92, 99, 100, 105, 116, 118, 123

Expedition I: Mann Range, 25.5.33–6.8.33
Personnel: N. B. Tindale, C. J. Hackett and A. Brumbie (cameleer)
Record cards and photographs: 129 individuals
Other photographs: *c.* 300
Sound recordings: 14 wax cylinders–N. B. Tindale (AIAS tapes 9574, 9575)
16 mm film: 4 reels (1405 ft–N. B. Tindale)
Crayon drawings: 131 sheets
Artefacts: *c.* 140
Publications: 48, 51, 65, 76, 89, 122, 123

Expedition I: Ernabella, 7.8.33–24.8.33
Personnel: J. B. Cleland, T. Harvey Johnston, C. S. Hicks, N. B. Tindale, J. H. Gray, C. J. Hackett, H. M. Hale, H. K. Fry, M. Lamshed, J. O'Connor (Hicks' assistant)
Record cards and photographs: 60 individuals
Other photographs: *c.* 200
Face and bust casts: 21
Sound recordings: 14 wax cylinders–N. B. Tindale (AIAS tape 9575)
16 mm film: 9 reels (2475 ft–H. K. Fry and N. B. Tindale)
Crayon drawings: 134 sheets
Artefacts: *c.* 220
Publications: 51, 52, 56–61, 69, 70, 73, 76, 83, 96, 99, 100, 110, 114, 118, 122, 123

Expedition J: Diamantina, 10.8.34–28.8.34
Personnel: J. B. Cleland, T. H. Johnston, T. D. Campbell, H. K. Fry, N. B. Tindale, F. Fenner (anthropometry), T. Vogelsang (history, ethnology), L. Wilkie (Director, Art Gallery of S.A., artist)
Record cards and photographs: 49 individuals
Other photographs: *c.* 120
Oil portraits: 8
Sound recordings: 14 wax cylinders–N. B. Tindale (AIAS tape 9568)
16 mm film: 3 reels (1200 ft–N. B. Tindale)
Artefacts: *c.* 75
Publications: 72, 75, 84, 93, 94, 105, 120, 123

Expedition K: Warburton Range, 26.7.35–6.9.35
Personnel: N. B. Tindale, C. J. Hackett, E. O. Stocker, C. P. Mountford (photography, art records), E. Gutteridge (assistant)
Record cards and photographs: 54 individuals
Other photographs: *c.* 120. See also Mountford-Sheard Collection, SLSA
Sound recordings: 14 wax cylinders–N. B. Tindale (AIAS tapes 9578, 9579)
16 mm film: 8 reels (2825 ft–E. O. Stocker)
Crayon Drawings: 301 sheets. See also Mountford-Sheard Collection, SLSA
Artefacts: *c.* 45
Publications: 66, 77, 80, 81, 86, 88, 101–104, 108, 109, 123

Expedition L: The Granites, 6.8.36–27.8.36
Personnel: J. B. Cleland, T. H. Johnston, H. K. Fry, C. P. Mountford, H. M. Hale, E. Couper Black (anthropometry, blood tests), O. Pink (anthropologist at Granites)
Record cards and photographs: 49 individuals
Other photographs: See Mountford-Sheard Collection, SLSA
Sound recordings: 2 wax cylinders (AIAS tape 9579)
16 mm film: 5 reels (1585 ft–H. K. Fry and C. P. Mountford)
Crayon drawings: See Mountford-Sheard Collection, SLSA
Artefacts: *c.* 30
Publications: 85, 87, 90, 97, 106, 121

Expedition M: Nepabunna, 22.5.37–3.6.37
Personnel: J. B. Cleland, C. P. Mountford, H. M. Hale, T. H. Johnston, E. Couper Black, H. K. Fry, H. M. Hale, F. Fenner, F. Hall (assistant)
Record cards and photographs: 10 individuals
Other photographs: See Mountford-Sheard Collection, SLSA
Face casts: 12
Sound recordings: 7 wax cylinders (AIAS tape 9579). See also Mountford-Sheard Collection, SLSA
16 mm film: See Mountford-Sheard Collection, SLSA
Drawings: See Mountford-Sheard Collection, SLSA
Artefacts: *c.* 35
Publications: 90, 95, 107, 110

[Expedition N: Harvard-Adelaide Universities Australia-wide expedition, 1938–1939. This expedition will be discussed in a later paper.]

Expedition O: Ooldea, 15.8.39–26.8.39
Personnel: J. B. Cleland, T. H. Harvey Johnston, E. C. Black, F. Fenner, R. M. Berndt (social anthropology), A. Harvey (assistant)
Record cards and photographs: 101 individuals
Other photographs: *c.* 100
Artefacts: *c.* 20
Publications: 112, 113, 119

Appendix 3: Bibliography of Publications Relating to Board Expeditions A-M, O

Publications have been listed for each year and are numbered to refer to each expedition (Appendix 2).

1926

1. CAMPBELL, T. D. & LEWIS, A. J. 1926. The Aborigines of South Australia: Anthropometric,

descriptive, and other observations recorded at Ooldea. *Trans. R. Soc. S. Aust.* **50**: 183–191.
2. CLELAND, J. B. 1926. Blood grouping of Australian Aborigines. *Aust. J. Exp. Biol. Med. Res.* **3**: 33–35.
3. JONES, F. W. 1926. The claims of the Australian Aborigine. Presidential Address (Section F-Anthropology), *AAAS Report* **18**: 497–519.

1927

4. CAMPBELL, T. D. & HACKETT, C. J. 1927. Adelaide University Field Anthropology, Central Australia. No. 1 Introduction, descriptive and anthropometric observations. *Trans. R. Soc. S. Aust.* **51**: 65–75.
5. CLELAND, J. B. 1927. Adelaide University Field Anthropology, Central Australia. No. 3 Blood grouping of Australian Aboriginals at Oodnadatta and Alice Springs. *Trans. R. Soc. S. Aust.* **51**: 78–80.
6. DAVIES, E. H. 1927. Adelaide University Field Anthropology, Central Australia. No. 4 Aboriginal Songs. *Trans. R. Soc. S. Aust.* **51**: 81–92.
7. DAVIES, E. H. 1927. Palaeolithic music. *Musical Times* **68**: 691–695.
8. RAY, W. 1927. Adelaide University Field Anthropology, Central Australia No. 2. Physiological Observations. *Trans. R. Soc. S. Aust.* **51**: 76–77.

1928

9. CAMPBELL, T. D. 1928. Adelaide University Field Anthropology, Central Australia No. 5. Dental Notes. *Trans. R. Soc. S. Aust.* **52**: 28–30.
10. CLELAND, J. B. 1928. Notes on dreams of Australian Aborigines. *Trans. R. Soc. S. Aust.* **52**: 240.

1929

11. CLELAND, J. B. & WOOLLARD, H. H. 1929. Further results in the blood grouping of South Australian Aborigines. *Med. J. Aust.* **2**: 2–7.
12. FRY, H. K. 1929. Testing the intelligence of Aboriginals. *Med. J. Aust.* **16**: 866.
13. WOOLLARD, H. H. & CLELAND, J. B. 1929. Anthropology and blood grouping with special references to the Australian Aborigines. *Man* **29**: no. 145.

1930

14. CAMPBELL, T. D. & MOORE, A. P. R. 1930. Adelaide University Field Anthropology. Dental notes, Koonibba, South Australia. *Aust. J. Dentistry* **34**: 123–127.
15. CLELAND, J. B. 1930. A short history of scurvy in Australia. *Med. J. Aust.* **17**: 2–4.
16. CLELAND, J. B. 1930. Further results in blood grouping Central Australian Aborigines. *Aust. J. Exp. Biol. Med. Res.* **7**: 79–89.
17. CLELAND, J. B. & FRY, H. K. 1930. An outbreak of scurvy with joint lesions in Australian Aborigines in Central Australia. *Med. J. Aust.* **17**: 5–7.
18. CLELAND, J. B., FRY, H. K. & MAEGRAITH, B. G. 1930. Notes on the pathological lesions and vital statistics of Australian natives in Central Australia. *Med J. Aust* **17**: 80–83.
19. FRY, H. K. 1930. Adelaide University Field Anthropology: physiological and psychological observations on the Australian Aborigines. *Trans. R. Soc. S. Aust.* **54**: 76–104.
20. PULLEINE, R. & WOOLLARD, H. H. 1930. Adelaide University Field Anthropology No. 6. Physiological and mental observations on the Australian Aborigines. *Trans. R. Soc. S. Aust.* **54**: 62–75.

1931

21. CLELAND, J. B. 1931. Blood grouping of Central Australian Aborigines. 1930 series. *J. Trop. Med. Hyg.* **24**: 353–358.
22. CLELAND, J. B. 1931. Botanical notes on Central Australia. *S. Aust. Nat.* **12**: 64–67.
23. FRY, H. K. & PULLEINE, R. H. 1931. The mentality of the Australian Aborigine. *Aust. J. Exp. Biol. Med.* **8**: 153–167.
24. FRY, H. K. 1931. Adelaide University Field Anthropology, Central Australia. No. 8 — A table showing the class relations of the Aranda. *Trans. R. Soc. S. Aust.* **55**: 12–19.
25. FRY, H. K. 1931. Adelaide University Field Anthropology Central Australia. No. 9 — On the class system, kinship terminology, and marriage regulations of the Australian native tribes. *Trans. R. Soc. S. Aust.* **55**: 20–22.
26. HICKS, C. S., MATTERS, R. F. & MITCHELL, M. L. 1931. The standard metabolism of Australian Aboriginals. *Aust. J. Exp. Biol. Med.* **8**: 69–82; **9**: 177–183.
27. TINDALE, N. B. 1931. Geological notes on the Iliaura country north-east of the MacDonnell Range, Central Australia. *Trans. R. Soc. S. Aust.* **55**: 32–38.
28. TINDALE, N. B. 1931. Anthropological expedition to Central Australia. *Med. J. Aust.* **18**: 793–796.

1932

29. CLELAND, J. B. 1932. The blood grouping of Central Australian Aborigines, 1931 series. *J. Trop. Med. Hyg.* **35**: 369–371.
30. CLELAND, J. B. 1932. Botanical notes on Central Australia. Part 2. *S. Aust. Nat.* **13**: 112–114.
31. CLELAND, J. B. 1932. Field anthropology in Australia. *Science* **75**: 50–52.
32. CLELAND, J. B. 1932. Adelaide University Field Anthropology, Central Australia. No. 12 — Botanical notes of anthropological interest from MacDonald Downs, Central Australia. *Trans. R. Soc. S. Aust.* **56**: 36–38.
33. DAVIES, E. H. 1932. Aboriginal songs of Central and Southern Australia. *Oceania* **3**: 454–467.
34. FRY, H. K. 1932. Adelaide University Field Anthropology, Central Australia. No. 11 — Genealogical studies of Australian tribal systems. *Trans. R. Soc. S. Aust. 56*: 27–35.
35. MAEGRAITH, B. G. 1932. Adelaide University Field Anthropology, Central Australia. No. 10 — The astronomy of the Aranda and Luritja tribes. *Trans. R. Soc. S. Aust.* **56**: 19–26.
36. TINDALE, N. B. 1932. Primitive art of the Australian Aborigines. *Manuscripts* **3**: 38–42.
37. TINDALE, N. B. 1932. Notes on the supposed primitive implements from the tableland regions of Central Australia. *Rec. S. Aust. Mus.* **4**: 483–488.

1933

38. CLELAND, J. B. 1933. Blood grouping of Central Australian Aborigines, 1932 series. *J. Trop. Med. Hyg.* **36**: 1-2.
39. CLELAND, J. B. 1933. University expedition to study the natives of Central Australia. *Science* **77**: 260-261.
40. CLELAND, J. B. 1933. Studying the Australian Aboriginal. *Discovery*, Feb. 1933: 48.
41. CLELAND, J. B. 1933. Natives of South Australia. *Nature* **132**: 996.
42. CLELAND, J. B. 1933. The Natives of Central Australia. *Med. J. Aust.* **20**: 332-334.
43. CLELAND, J. B. & GRAY, J. H. 1933. Some pathological conditions seen in Central Australian Aborigines. *J. Trop. Med. Hyg.* **36**: 125-128.
44. CLELAND, J. B. & JOHNSTON, T. H. 1933. The history of the Aboriginal narcotic, Pituri. *Oceania* **4**: 201-223; 268-290.
45. CLELAND, J. B. & JOHNSTON, T. H. 1933. The ecology of the Aborigines of Central Australia; botanical notes. *Trans. R. Soc. S. Aust.* **57**: 113-134.
46. FRY, H. K. 1933. Body and soul. A study from western Central Australia. *Oceania* **3**: 247-256.
47. FRY, H. K. 1933. Australian marriage rules. *Sociological Review* **25**: 258-277.
48. HICKS, C. S. & MATTERS, R. F. 1933. The standard metabolism of the Australian Aborigines. *Aust. J. Exp. Biol. Med.* **11**: 177-183.
49. TINDALE, N. B. 1933. Preliminary report on fieldwork among the Aborigines of the north-west of South Australia. *Oceania* **4**: 99-105.
50. TINDALE, N. B. 1933. Geological notes on the Cockatoo Creek and Mount Liebig country, Central Australia. *Trans. R. Soc. S. Aust.* **57**: 206-217.

1934

51. CLELAND, J. B. 1934. The natives of the north-west of South Australia. *Med. J. Aust.* **21**: 848-853.
52. CLELAND, J. B. & GRAY, J. H. 1934. Pathological lesions in Natives of Central Australia (Mount Liebig area). *J. Trop. Med. Hyg.* **37**: 305-311.
53. CLELAND, J. B. & GRAY, J. H. 1934. Pathological lesions met with amongst Aborigines in the Musgrave Ranges, South Australia. *J. Trop. Med. Hyg.* **37**: 305-311.
54. CLELAND, J. B. & JOHNSTON, T. H. 1934. The history of the Aboriginal narcotic, Pituri. *Oceania* **4**: 201-289.
55. FRY, H. K. 1934. Kinship in western Central Australia. *Oceania* **4**: 472-478.
56. FRY, H. K. 1934. Kinship and descent among the Australian Aborigines. *Trans. R. Soc. S. Aust.* **58**: 14-21.
57. HICKS, C. S., MOORE, H. O. & ELDRIDGE, E. 1934. The respiratory exhange of the Australian Aborigine. *Aust. J. Exp. Biol. Med.* **12**: 79-89.

1935

58. CLELAND, J. B. 1935. The native of Central Australia and his surroundings. *Proc. R. Geog. Soc. Aust., S. Aust. Branch* **35**: 66-81.
59. FRY, H. K. 1935. Native life in Central Australia. *Man* **35**: No.114.
60. FRY, H. K. 1935. Aboriginal mentality (resume). *Mankind* **1**: 267-268.
61. GRAY, J. H. 1935. Hair tracts of the Australian Aboriginal. *J. Anatomy* **59**: 206-225.
62. HICKS, C. S. & LEMESSURIER, H. 1935. Preliminary observations on the chemistry and pharmacology of the alkaloids of *Duboisia hopwoodii*. *Aust. J. Exp. Biol. Med.* **13**: 175-188.
63. HICKS, C. S., BRUCKE, F. TH. & HUEBER, E. F. 1935. Uber die Pharmakologie der *Duboisia hopwoodii* (D-Nornikotin). *Archives internationale de Pharmacodynamie et de Therapie* **40**: 335-353.
64. MAEGRAITH, B. G. 1935. 'Our Stone Age Contemporaries, the Aborigines of Central Australia'. London.
65. TINDALE, N. B. 1935. Initiation among the Pitjandjara natives of the Mann and Tomkinson Ranges in South Australia. *Oceania* **6**: 199-224.
66. TINDALE, N. B. 1935. The Australian Aboriginal: his arts and crafts. *Progress in Aust.* **5**(11): 18-20; (12) 9-11.
67. TINDALE, N. B. 1935. General report on the anthropological expedition to the Warburton Range, Western Australia, July-September, 1935. *Oceania* **6**: 481-85.

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68. CAMPBELL, T. D. & GRAY, J. H. 1936. Observations on the teeth of Australian Aborigines. *Aust. J. Dent.* **40**: 290-95.
69. CAMPBELL, T. D., GRAY, J. H. & HACKETT, C. J. 1936. Physical anthropology of the Aborigines of Central Australia. *Oceania* **6**: 106-139; 246-261.
70. CLELAND, J. B. 1936. The botanical features between Oodnadatta and Ernabella in the Musgrave Ranges with a locality list of plants from the north-west of South Australia identified by Mr J. M. Black, A.I.S. *Trans. R. Soc. S. Aust.* **60**: 114-126.
71. CLELAND, J. B. 1936. Ethno-botany in relation to the Central Australian Aboriginal. *Mankind* **2**: 6-9.
72. CLELAND, J. B. & JOHNSTON, T. H. 1936. Blood grouping of the Aborigines of the Diamantina district in the north-east of South Australia. *J. Trop. Med. Hyg.* **39**: 104-105.
73. CLELAND, J. B., JOHNSTON, T. H. & HACKETT, C. J. 1936. Blood grouping of the Aborigines of the Musgrave Ranges in the north-west of South Australia. *J. Trop. Med. Hyg.* **39**: 25-28.
74. CLELAND, J. B. & TINDALE, N. B. 1936. Natives of South Australia. *In* 'The Centenary History of South Australia'. R. Geog. Soc. Aust., S. Aust. Branch, Adelaide: 16-29.
75. FENNER, F. J. 1936. Adelaide University field anthropology, Central Australia. No. 13 — Anthropomorphic observations on South Australian Aborigines of the Diamantina and Cooper Creek regions. *Trans. R. Soc. S. Aust.* **60**: 46-54.
76. HACKETT, C. J. 1936. 'Boomerang leg and yaws in Australian Aborigines'. R. Soc. Tropical Medicine and Hygiene. Monograph no.1.
77. HACKETT, C. J. 1936. On the carriage of serum for the Wasserman test. *Med. J. Aust.* **23**: 650.

78. HICKS, C. S. 1936. Further observations on the chemistry of d-Nor-Nicotine. An alkaloid of *Duboisia hopwoodii*. *Aust. J. Exp. Biol. Med.* **14**: 39–43.
79. SPATH, E., HICKS, C. S. & ZAJIC, E. 1936. Uber das d-Nor-Nicotin. *Berichte der deutschen chemischen Gesellschaft* **68**: 250–251.
80. TINDALE, N. B. 1936. General report on the anthropological expedition to the Warburton Range, Western Australia, July–September 1935. *Oceania* **6**: 482–485.
81. TINDALE, N. B. 1936. Legend of the Wati Kutjara, Warburton Range, Western Australia. *Oceania* **7**: 169–185.

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82. CAMPBELL, T. D. 1937. Observations on the teeth of Australian Aborigines, Hermannsburg. *Aust. J. Dent.* **41**: 1–6.
83. CLELAND, J. B. & JOHNSTON, T. H. 1937. Notes on native names and uses of plants in the Musgrave Ranges region. *Oceania* **8**: 208–215; 328–342.
84. FRY, H. K. 1937. Dieri legends. *Folk Lore* **48**: 187–206; 269–287.
85. HACKETT, C. J. 1937. Man and nature in Central Australia *Geographical Magazine* **4**: 287–304.
86. MOUNTFORD, C. P. 1937. Aboriginal crayon drawings from the Warburton Ranges in Western Australia relating to the wanderings of two ancestral beings, the Wati Kutjara. *Rec. S. Aust. Mus.* **6**: 5–28.
87. MOUNTFORD, C. P. 1937. Aboriginal crayon drawings, relating to totemic places belonging to the northern Aranda tribe of Central Australia. *Trans. R. Soc. S. Aust.* **61**: 81–95.
88. MOUNTFORD, C. P. 1937. Rock paintings at Windulda, Western Australia. *Oceania* **7**: 429–435.
89. TINDALE, N. B. 1937. Natives of the Western Desert of Australia. *Man* **37**: no. 34.

1938

90. BLACK, E. C. & CLELAND, J. B. 1938. Pathological lesions in Australian Aborigines, Central Australia (Granites) and Flinders Ranges. *J. Trop. Med. Hyg.* **41**: 69–83.
91. CAMPBELL, T. D. 1938. Observations on the teeth of Australian Aborigines, Cockatoo Creek, Central Australia. *Aust. J. Dent.* **42**: 44–47.
92. CAMPBELL, T. D. 1938. Observations on the teeth of Australian Aborigines, Mt. Liebig, Central Australia. *Aust. J. Dent.* **42**: 85.
93. CAMPBELL, T. D. 1938. Observations on the teeth of Australian Aborigines, River Diamantina, S.A. *Aust. J. Dent.* **42**: 121.
94. CLELAND, J. B. 1938. Pathological lesions met with in Aborigines of the Diamantina district in the north-east of South Australia. *J. Trop. Med. Hyg.* **41**: 57–58.
95. CLELAND, J. B. & JOHNSTON, T. H. 1938. Blood-grouping of Aborigines of the northern Flinders Ranges in South Australia. *J. Trop. Med. Hyg.* **41**: 26–27.
96. CLELAND, J. B. & JOHNSTON, T. H. 1938. Notes on native names and uses of plants in the Musgrave Ranges region. *Oceania* **8**: 208-215; 328–342.
97. CLELAND, J. B. & JOHNSTON, T. H. 1938. Blood grouping of Aborigines in the north-west portion of Central Australia. 1936 series. *J. Trop. Med. Hyg.* **41**: 10–12.
98. FRY, H. K. 1938. 'Fear in Primitive Society'. Occasional Publication no. 1, Anthropological Soc. S. Aust., Adelaide.
99. HICKS, C. S. & O'CONNOR, W. J. 1938. Skin temperature of Australian Aboriginals under varying atmospheric conditions. *Aust. J. Exp. Biol. Med.* **14**: 1–18.
100. HICKS, C. S. & O'CONNOR, W. J. 1938. The effect of changes of environmental temperature on the skin circulation of the naked Aboriginal, as measured by the Sahli-Jaquet volume-bolography. *Aust. J. Exp. Biol. Med.* **14**: 19–38.
101. MOUNTFORD, C. P. 1938. Aboriginal crayon drawings 3: The legend of Wati-Jula and the Kunkarunkara women. *Trans. R. Soc. S. Aust.* **62**: 241–254.
102. MOUNTFORD, C. P. 1938. Contrast in drawings made by an Australian Aborigine before and after initiation. *Rec. S. Aust. Mus.* **6**: 111–114.
103. MOUNTFORD, C. P. 1938. Gesture language of the Ngada tribe of the Warburton Ranges, Western Australia. *Oceania* **9**: 152–155.
104. TINDALE, N. B. 1938. A game from the Great Western Desert of Australia. *Man* **38**: no. 145.

1939

105. CAMPBELL, T. D. 1939. Food, food values and food habits of the Australian Aborigines in relation to their dental conditions, Parts 1–5. *Aust. J. Dent.* **43**: 1–15; 45–55; 73–87; 141–156; 177–198.
106. CLELAND, J. B. & JOHNSTON, T. H. 1939. Aboriginal names and uses of plants at the Granites, Central Australia. *Trans. R. Soc. S. Aust.* **63**: 22–26.
107. CLELAND, J. B. & JOHNSTON, T. H. 1939. Aboriginal names and uses of plants in Northern Flinders Ranges. *Trans. R. Soc. S. Aust.* **63**: 172–179.
108. MOUNTFORD, C. P. 1939. Aboriginal crayon drawings 4: Relating to everyday incidents of the Ngada tribe of the Warburton Ranges of Western Australia. *Trans. R. Soc. S. Aust.* **63**: 1–13.
109. MOUNTFORD, C. P. 1939. Aboriginal crayon drawings, Warburton Ranges, Western Australia. *Oceania* **10**: 72–79.
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Art and Land: Aboriginal Sculptures of the Lake Eyre Region by Philip Jones and Peter Sutton (with special assistance by Kaye Clark). South Australian Museum in association with Wakefield Press, Adelaide, 1986. 144 pp., 119 numbered figs (57 in colour), 431 additional black-and-white illustrations. Paperbound $A29.95.

It is some indication of the present state of Australian ethnographic studies in general and museum publication policies in particular, that the first thing which must be recorded about 'Art and Land' is just how welcome is a catalogue — any catalogue — in this field.

In contrast, throughout Europe the old tradition of the production of meticulously documented bodies of material supported by relevant commentary continues: in the context of Australasian ethnography consider, among others, the work of the Museums für Völkerkunde in Berlin (West) or Basel. Here in Australia itself in recent years one can only turn to special exhibition catalogues such as that of the ill-fated 'Aboriginal Australia' (Art Gallery Directors' Council, Sydney 1981), or the few of any scholarly weight emanating from the Art Gallery side of the Great Institutional Divide (amongst the exceptions see most recently, Maughan & Zimmer (Eds.) 'Dot and Circle: A Retrospective Survey of the Aboriginal Acrylic Paintings of Central Australia', R.M.I.T., Melbourne, 1986). As a true example of the basic working tool of the material culture specialist — a dying breed one must assume, despite the best efforts of Professor Barrie Reynolds and his colleagues at James Cook University — I can only think of David R. Moore's 'The Torres Strait Collection of A. C. Haddon' (British Museum Publications, London, 1983). This suggests two things: firstly, scholars indeed have no need of the 'traditional' *catalogue raisonné*. (If so, why do they continue to be produced in the related fields of archaeology and art history, in many cases with the aid of the 'new information technology' of microfiche, interactive videodisc, etc?) Secondly, it suggests that publication of works of scholarship no longer needs to have a high priority in our public museums, dedicated as they are to an ever-increasing public role. I believe neither of these to be true.

'Art and Land', like the exhibition to which it forms a necessary and seemingly necessarily high-cost adjunct, attempts two things: to record a discrete body of material and to present it in such a way as to attract general attention to a little-known aspect of South Australian Aboriginal material culture — suitably enough, in the State's sesquicentenary year and in the international forum of Adelaide's Festival of Arts.

'Art and Land' is the work of two members of the staff of the South Australian Museum. Philip Jones, an historian, has contributed Chapters 2–4, on the mission history of the area; on the main figure in that history, Pastor Reuther; and a detailed description culminating in a catalogue (prepared with Kaye Clark), of the 421 known extant toas and seven related dog figurines now in Australian, German and New Zealand collections. Peter Sutton, Head of the Division of Anthropology at the South Australian Museum and an anthropologist by training, has written the Introduction and Chapter 5, entitled 'From object into subject', as well as Chapter 1, 'The sculptors and their background'.

In addition to the small group of dog figurines in painted and modelled spinifex gum, the toas — a term whose origin, like much else about the material, is obscure and still largely a matter for speculation — are small sculptures of wood and gypsum painted in natural earth colours. Three subtypes are identified: Type I with a natural object or artefact attached to the head, type II with actual moulded or carved representations of artefacts or natural objects, and type III, toas decorated with painted designs only.

This is supposed to be a review of the publication and not of the exhibition — whose design by Ian Maidment is reflected in part by Peter Goeldi's over-fussy design of the book with its frustrating habit of over-reduction of relevant documentary material (Figs 75, 79, 102–107). The exhibition may be categorised as a good example of the 'object-as-individual-treasures' approach thoroughly established in the 1960s and early 1970s by such international successes, but largely academic failures, as 'The Treasures of Tutankhamun' (British Museum, London, 1972) or 'Sacred Circles: Two Thousand Years of North American Indian Art' (Arts Council of Great Britain, 1976-77). The design of the book seems to exhibit in its turn the difficulties of putting within one and the same covers an attractive visual package and a usable scholarly tool. Notwithstanding, one may comment that exhibition designers and booksellers alike know only too well that very often what's in a name is a difference between public success and failure. (The major 1986 Adelaide Festival presentation of the Art Gallery of South Australia, 'Wild Visionary Spectral', is a case in point as to how the very title may be sufficient to keep them away in droves.) 'Art and Land' offers its own direction markers as to where its devisers intend to take us. It is admittedly all too question-begging a title, but too much

printing ink has already been spilt and too many words have already been processed as to whether or not the authors are correct in claiming — or rather suggesting — that their chosen subject matter is in fact 'art', whether 'art' is to be regarded simply as 'cultural artefacts of high value', as a form of communication, or merely as whatever the viewer thinks it means. For those who are concerned to fight over this particular arid battle-ground again, it must suffice here to refer to Donald Brook's article 'Without wishing to tread on anyone's toas', *Artlink* 6: 2/3 (June/July 1986), 4–5; Peter Sutton on 'The sculpted word: a reply to Donald Brook on toas', *Adelaide Review* 32 (November 1986), and the response in turn by Brook, 'Touching one's toas', *Adelaide Review* 33 (December 1986). All of which proves, as if one didn't already know, that philosophers are more cunning word-smiths than anthropologists and that, in the present context, neither can prove the truth of an argument, the settling of which must be regarded as a matter of supreme indifference to the culture which has sparked off yet another chapter in the old Euro-centric debate as to 'what is art?' The (only slightly) more important question as to whether this material was originally produced as 'art' by its makers is, however, not one fully addressed by the authors of 'Art and Land' in their book. And this, despite the (unattributed) reference to Rudyard Kipling's often quoted 'Conundrum' (p. 18), and their expressed aim to expose 'the layers of added meaning' acquired by the material since its manufacture; exposing 'the additive process to open view so that all the associations of the sculptures, not just the record of their "original meanings", may be understood' (p. 12).

But just what *is* this material which has here been so carefully illustrated and described? It is this question as to the original purpose served by the toas which certainly interests me as an archaeologist of art.

The original collector of the toas was Johann Georg Reuther (1861–1914), Pastor of the Lutheran Mission of Killalpaninna where, prior to his transfer to Hermannsburg in 1895, Carl Strehlow had worked. The evidence of Reuther's meticulously kept ethnographic accounts of the region supported by the illustrations prepared for him and the independent comments of H. J. Hillier, the then school master at the Mission (significantly the only contemporary sources of information on the toas), suggest the manufacture of the toas over a short period of time between 1890 and 1905. In what in many ways is the most interesting — and instructive — section of his historical commentary entitled 'The Great Toa Hoax?' (pp. 54–61), Jones makes it clear that much of the controversy which has subsequently surrounded the toas can be referred to the quest for a uniting and unifying explanation for their general production. The Melbourne collector A. S. Kenyon in 1920, and George Aiston in 1938 both expressed extreme doubts as to the authenticity of the toas. An alternative and much more complex hypothesis can be advanced in the light of several seemingly unrelated factors: the apparently extremely short-lived period of their production; the demonstration by Howard Morphy in his 1972 London M. Phil. thesis that a study of toa symbolism indicates in them the use of certain visual conventions, systematic but without the grammar and semantics of a natural language; Reuther and Hillier's own limited command of the Aboriginal languages spoken on the mission; Hillier's own training as an artist; and lastly and certainly not least, the fact that Reuther's collection which in 1903 had been offered to a visiting Russian ornithologist, A. L. Yashchenko for 10 English pounds finally passed to the South Australian Museum in 1907 for forty times that amount.

The answer to the conundrum is perhaps over-simply but honestly summarised in the free guide which now — though not at its opening, alas — accompanies the exhibition; the symbols and designs of the toas represent hundreds of places in the country east of Lake Eyre. The toas tell the stories of the *Muramuras* or creation ancestors moving throughout the region during their Dreaming wanderings. The guide continues: 'Although the toas have been described as direction markers or sign-posts, it has not been proven that they were used for this purpose. The evidence suggests that Aboriginal people made the toas in order to depict their country and their beliefs'. The foreword to the book (pp. 8–9) is written by Emeritus Professor Ronald Berndt, most recent in the line of distinguished German South Australians concerned with the study of Aboriginal culture. Largely on the strength of his own early contact with the Diyari, the main tribal group of the area, Berndt is much more definite as to the sign-post — and signing — role of the toas. He calls them 'public religious statements, available for all to see, although many of the designs of them were not unlike those on secret-sacred objects'. These are features which are of course shared by many other items of Aboriginal material culture even in most recent times, and to which the label 'art' has largely uncontentiously been applied. The acrylic paintings of the Centre are an example. Berndt's further comment in his foreword that the toas 'enshrined the Aboriginal empathy with the land' is, I feel, the key to the debate. Christopher Pearson in a lucid summary on 'Aboriginal toas — hoax or mystery?' *Adelaide Review* 23, Festival 1986) suggests that the 'mystery' is to be explained by a lack of recognition of just how adaptable aspects of Aboriginal culture

are to change, something which Jones (p. 61) refers to as 'the continuing metamorphosis and transformation of Aboriginal artistic traditions'.

In the toas one may see confirmation of what indeed the Hermannsburg school water-colours and to a more immediately significant degree, the Central Australian acrylic paintings demonstrate: that multiple meanings can be enshrined in the one simple visual vocabulary and that, conversely, the same meaning may be given for different symbols. Also, the fact that an 'art' form is 'new' or European-inspired does not invalidate its essential Aboriginality, its power to make meaningful and complex statements about land-human relationships. In this, of course, the toas are no different from the contemporary explosion of differing forms of visual statements made by Aboriginals both in 'traditional' and urban communities.

But that, to quote Kipling again, is another story.

J. V. S. MEGAW, Visual Arts, The Flinders University of South Australia, Bedford Park, South Australia 5042.

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REVISION OF AUSTRALIAN *BEROSUS* LEACH (COLEOPTERA: HYDROPHILIDAE)

C. H. S. WATTS

WATTS, C. H. S. 1987. Revision of Australian *Berosus* Leach (Coleoptera: Hydrophilidae). *Rec. S. Aust. Mus.* **21**(1): 1–28.

The Australian members of the hydrophilid genus *Berosus* are revised and redescribed. A key to species is given. Thirty-two species are recognised of which 18 are described as new: *B. amoenus, B. arcus, B. aquilo, B. dallasae, B. gibbae, B. josephenae, B. juxtadiscolor, B. reardoni, B. macropunctatus, B. sadieae B. nicholasi, B. niger, B. quadrapunctatus, B. trishae, B. timmsi, B. veronicae, B. ralphi* and *B. vijae.*

The following synonymies are proposed: *B. flindersi* Blackburn = *B. discolor* Blackburn: *B. ovipennis* Fairmaire = *B. simulans* Blackburn = *B. stigmaticollis* Fairmaire = *B. auriceps* Blackburn = *B. blackburni* Zaitz = *B. approximans* Fairmaire; *B. quartinus* d'Orchmont = *B. queenslandicus* Blackburn; *B. gravis* Blackburn = *B. australiae* Mulsant.

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The hydrophilid fauna of Australia is relatively rich in species and numbers of individuals. They form a conspicuous part of the aquatic fauna. In general they are well-collected and well-represented in collections. Despite this they have received little recent taxonomic attention.

A major difficulty in dealing with *Berosus* Leach, 1817 in Australia was the inadequacies of existing keys which reflected a weak taxonomic base exemplified by the fact that some 18 of the 32 known species were undescribed, including the commonest southern species. At the same time some widespread species were described under as many as five different names.

The last major attempt to revise Australian *Berosus* was by Blackburn in 1898.

Some characters used in the key, such as leg colour and details of the punctation, are not totally reliable, but the male genitalia have provided good characters in all cases.

The genus *Berosus* is a member of the subfamily Berosinae which is characterized by a markedly deflexed head, seven- or eight-segmented antennae and meso- and metasternae without a continuous common keel.

Berosus can be separated from the other Australian genera in the subfamily (*Regimbartia, Globaria* and *Amphiops*) by possession of protruding eyes, seven-segmented antennae, and striae on elytra, although in some species these are partially masked by strong elytral punctations. Adults of all but a few of the smaller species are yellow-brown in colour. They are found mainly among vegetation at the bottom and sides of ponds and pools. Adults are often taken at light sometimes some distance from water. The larvae are distinctive with a series of lateral filamentous appendages and live in pools in similar situations to the adults. I know of no detailed description of the larvae of any Australian species.

Berosus is a large cosmopolitan genus and many attempts have been made to subdivide it, none of which appear particularly satisfactory to me. In particular, the subgenus *Hygrotrophus* W. Macleay which includes only the species *B. (H.) nutans* and *B. (H.) devisi*, both Australian species, seems unwarranted and to be based on an undue emphasis on the punctation of the upper surface.

Within Australian species there are five more or less distinctive groupings.

Group 1 species are small, have the midline of the mesosternum produced downwards in a distinct ridge, head black, metacoxal process weakly to moderately lobed laterally, last abdominal segment notched and the second elytral stria 1/4 the length of the elytron (*B. discolor, B. approximans, B. reardoni, B. juxtadiscolor, B. timmsi*).

Group 2 species are small, with the midline of the mesosternum produced downwards in a distinct pillar, head black, metacoxal process strongly lobed laterally, the last abdominal segment notched, the second elytral stria about 1/2 the length of elytron, and with strongly developed medial ridge on first abdominal segment (*B. macropunctatus, B. quadrapunctatus, B. trishae*).

Group 3 species are similar to Group 2 species except for a less developed medial ridge on first abdominal segment, strongly humpbacked which is associated with the presence of a space between elytral striae 7 and 8 and/or 8 and 9 in the middle of the elytron (*B. involutus, B. niger, B. arcus*).

Group 4 species are similar to Group 2 but are

larger and have the second elytral stria reaching about two-thirds the length of the elytron (*B. duplopunctatus* and *B. queenslandicus*).

Group 5 species are generally larger with brown heads, midline of mesosternum with a weak central keel, and metacoxal process without lateral lobes (*B. nutans, B. pulchellus, B. dallasi, B. macumbensis, B. munitipennis, B. amoenus, B. josephenae, B. gibbae, B. majusculus, B. veronicae, B. aquilo, B. australiae, B. decipiens, B. sadieae, B. nicholasi, B. vijae, B. subovatus, B. ralphi* and *B. debilipennis*).

Groups 1–4 have similarities with each other and roughly correspond to the subgenus *Berosus* Hope. Group 5 species correspond to the subgenera *Enoplurus* Hope and *Hygrotrophus* W. MacLeay. Since *Berosus* is a world-wide genus, further consideration of subgeneric groupings should include extra-Australian species and is beyond the scope of this revision.

The collections from which specimens were examined are listed under the following abbreviations:

AM	Australian Museum, Sydney.
ANIC	Australian National Insect Collection, Canberra.
BM(NH)	British Museum (Natural History), London.
CW	Private collection of author.
NMV	National Museum of Victoria, Melbourne.
NSW DA	New South Wales Department of Agriculture, Sydney.
NTM	Northern Territory Museum, Darwin.
MNHN	Museum National d'Histoire Naturelle, Paris.
SAM	South Australian Museum, Adelaide.
WAM	Western Australian Museum, Perth.
QPI	Queensland Department of Primary Industry, Mareeba.

Key to Australian Species of *Berosus*

1. Midline of mesosternum produced downwards in a distinct pillar (Fig. 10), not projecting backwards between metacoxae. Head black (metallic). Metacoxal process lobed laterally (rudimentary in *B. discolor*). Last abdominal segment notched. Small (<7 mm) 2
1. Midline of mesosternum with weak central keel, projecting weakly forward between mesocoxae. Head completely or partially brown except *B. pulchellus* which lacks elytral striae and *B. amoenus* which has a predominantly black pronotum and elytra also. Metacoxal process triangular (Fig. 1) 14
2. (1) Second elytral stria about 1/4 length of elytron3
2. Second elytral stria ⩾1/2 length of elytron .6
3. (2) Rugose portion of metafemur <1/2 length of femur (Fig. 2). Mesosternal pillar flat on ventral edge .....*B. discolor* Blackburn
3. Rugose portion of metafemur ⩾1/2 length of femur. Mesosternal pillar weakly concave on ventral edge 4
4. (3) Rugose portion of mesofemur 1/2–2/3 length of femur 5
4. Rugose portion of mesofemur <1/2 length of femur .....*B. approximans* Fairmaire
5. (4) Rugose portion of meta- and meso-femora pale, same colour as rest of leg . *B. reardoni* sp.nov.
5. Rugose portions of meta- and meso-femora much darker than rest of leg 7
6. (2) Second elytral stria about 1/2 length of elytron, rugose portion of metafemur ⩾1/2 length of femur 8
6. Second elytral stria at least 2/3 length of elytron, rugose portion of metafemur <1/2 length of femur 13
7. (5) Punctures on sides of pronotum uneven in size, interstrial punctures small, subobsolete, hind femur of male with triangular bulge on hind edge .....*B. timmsi* sp.nov
7. Punctures on sides of pronotum evenly sized with only a few smaller ones, interstrial punctures moderately marked, hind femur of male normal .....*B. juxtadiscolor* sp.nov.
8. (6) Space between elytral striae 7 and 8 and/or 8 and 9 greater in middle than at ends of elytron (Fig. 8). Medial ridge on first abdominal segment 1/4 as deep as long, without backward projection on ventral edge 9
8. Elytral striae 7, 8 and 9 subparallel with each other. Medial ridge on first abdominal segment deep 1/3–1/2 as deep as long, with a backward projection on ventral edge 11
9. (8) Elytral stria 8 raised and carinate in middle and towards apex. Distance between elytral striae 8 and 9 greatly enlarged in middle (Fig. 8). Interstrial punctures weak, subobsolete. Northern species 10
9. Elytral stria 8 not raised. Interstriae 7–8 as wide or wider than 8–9 (Fig. 9). Interstrial punctures moderately strong. Southern species .....*B. involutus* MacLeay
10. (9) Rugose portion of metafemur approximately 1/2 length of femur. Punctures on disc of pronotum of two sizes, larger predominating. Posterior portion of carinate eighth interstria at right angles to edge of elytron. Black, except for interstria in apical 1/4 of elytron .....*B. niger* sp.nov.
10. Rugose portion of metafemur reaches 2/3 length of femur on rear edge. Punctures on disc of pronotum of one size, posterior portion of carinate eighth interstria of approximately 45° to edge of elytron (Fig. 8) ...*B. arcus* sp.nov.
11. (8) Pronotum smooth, shiny, moderately covered with large punctures often with spaces greater than 1/2 diameter of puncture or greater between punctures. Pronotum yellow with three longitudinal black stripes 12
11. Head and pronotum rugose, densely covered with large punctures, those on pronotum separated

by narrow ridges. Pronotum black except for extreme lateral margins ..... *B. macropunctatus* sp.nov.

12. (11) Rugose portions of mesofemur a little under 1/2 length of femur ..*B. quadropunctatus* sp.nov.
12. Rugose portions of mesofemur 1/2–2/3 length of femur .....*B. trishae* sp.nov.
13. (6) Punctures on pronotum of two distinct sizes. Areas between elytral striae with shallow punctures.....*B. duplopunctatus* Blackburn
13. Punctures on pronotum vary little in size. Areas between elytral striae virtually impunctate ... . *B. queenslandicus* Blackburn
14. (1) Punctures on elytron densely and evenly distributed, each with a short seta. Punctures in elytral striae difficult to distinguish from those in interstriae 15
14. Punctures on elytra mostly without setae. Punctures in elytral interstriae scattered, distinct from those in striae 17
15. (14) Punctures on pronotum expanded laterally forming a dense network of closely spaced short striae orientated across the pronotum (Fig. 5) .....*B. nutans* W. MacLeay
15. Punctures on pronotum normal 16
16. (15) Small (<5.0 mm), elytron without striae. Head metallic black.....*B. pulchellus* W. MacLeay
16. Larger (>3.6 mm), elytra with deeply impressed striae. Rear of head with dark markings .... *B. dallasi* sp.nov.
17. (14) Interstrial punctures towards sides of elytra not as numerous as as those on disc, often arranged in a single row 18
17. Interstrial punctures towards sides of elytra more numerous and larger than those on disc, never arranged in single lines..... .....*B. macumbensis* Blackburn
18. (17) Outer apical spine on elytron long and thin (Fig. 3). Interstrial punctures laterally subobsolete, arranged in one row over most of elytron. Rugose portion of metafemur approximately 1/3–2/3 length of femur. Pale ....*B. munitipennis* Blackburn
18. Not with above combination of characters (Fig. 3) 19
19. (18) Punctures in interstria 3 of two sizes, with small size predominating (Fig. 11). Punctures on disc of pronotum of two sizes mostly large with some smaller ones (e.g. Fig. 7) 22
19. Punctures in interstria 3 of one size, or with only an occasionally smaller one. Punctures on disc of pronotum of one size (e.g. Fig. 6) 20
20. (19) Head black. Interstrial punctures on elytron approximately the same size as those in striae .....*B. amoenus* sp.nov.
20. Head pale brown. Interstrial punctures on elytron smaller than those in striae 21
21. (20) Rugose portions of femore dark-brown ....*B. josephenae* sp.nov.
21. Rugose portion of femore pale-brown .... *B. gibbae* sp.nov.
22. (19) Rugose portions of meso- and meta-femore noticeably darker than rest of femursee Table 1.
22. Rugose portions of meso- and metafemore of same colour as rest of femur 23
23. (22) Larger (>5.9 mm). Number of punctures in second elytral interstria to level of end of second stria >22. Rugose portion of mesofemur approx. 1/3 length of femur. Male with apical abdominal segment notched ....*B. majusculus* Blackburn
23. Smaller (<6.5 mm). Number of punctures in second elytral interstria back to level of end of second stria usually <26. Rugose portion of mesofemur >1/2 length of femur except in *B. veronicae* 24
24. Rugose portion of mesofemur ⩽ 1/2. Apical spines on elytron moderately developed (Fig. 4) ..... *B. veronicae* sp.nov.
24. Rugose portion of mesofemur >1/2 length of femur .....see Table 2.

SYSTEMATICS

Berosus discolor Blackburn
(Figs 2, 13, 18)

Berosus discolor Blackburn, 1888(1889), p. 829
Berosus flindersi Blackburn, 1888(1889), p. 831, syn. nov.

TABLE 1. Distinguishing characters for four species of *Berosus*.

B. aquilo sp. nov.	*B. australiae* Mulsant	*B. decipiens* Blackburn	*B. sadiae* sp. nov.
3.3–5.0 mm long	6.5–9.0 mm long	6.1–8.0 mm long	4.5–5.0 mm long
Tips of elytron usually without spines.	Tips of elytron with well-developed spines.	Tips of elytron with well-developed spines.	Tips of elytron usually with well-developed spines.
Third segment of male protarsi approximately same length as segment.	Third segment of male protarsi shorter than second segment.	Third segment of male length of second segment.	Third segment of male length of second segment.
Elytral punctures weak. Strial punctures arranged in one line, over most of elytron.	Elytral punctures usually strong, strial punctures not arranged in one line inwards from stria 7.	Elytral punctures usually weak, strial punctures usually arranged in one line over most of elytron.	Elytral punctures usually weak, strial punctures usually arranged in one line over most of elytron.
Coastal Northern Territory.	Australia-wide.	Wyndham to Cairns.	Coastal Northern Territory.

TABLE 2. Distinguishing characters for five species of *Berosus*.

B. debilipennis Blackburn	*B. subovatus* Knisch	*B. vijae* sp. nov.	*B. nicholasi* sp. nov.	*B. ralphi* sp. nov.
4.0–6.0 mm long	3.0–5.0 mm long	3.0–4.5 mm long	5.0–6.5 mm long	3.5–4.5 mm long
Apex of elytron rounded or with weak spines.	Apex of elytron rounded or weakly truncated.	Apex of elytron with weak spines.	Apex of elytron with weak to moderate spines.	Apex of elytron truncated or with weak spines.
Punctures in 1st elytral interstria, scattered, not arranged in a row.	Punctures in 1st elytral interstria, arranged in a single row.	Punctures in 1st elytral interstria, arranged in a single row.	Punctures in 1st elytral interstria, scattered, not arranged in a row.	Punctures in 1st elytral interstria, scattered, not arranged in a single row.
Lateral punctation on elytron moderate to strong.	Lateral punctation on elytron weak.	Lateral punctation on elytron moderate to strong.	Lateral punctation on elytron small and weak.	Lateral punctation on elytron small and weak.
Tip of postcoxal process in same plane as rest of underside.	Tip of postcoxal process in same plane as rest of underside.	Tip of postcoxal process in same plane as rest of underside.	Tip of postcoxal process in same plane as rest of underside.	Tip of postcoxal process bent downwards at 45° to rest of underside.
10–18 punctures in second elytral stria.	6–7 punctures in second elytral stria.	8–13 punctures in second elytral stria.	10–16 punctures in second elytral stria.	7–13 punctures in second elytral stria.
First segment of male protarsi much longer than second.	First segment of male protarsi longer than second.	First segment of male protarsi equal in length to second.	First segment of male protarsi equal in length to second.	First segment of male protarsi longer than second.

Types

Berosus discolor: Holotype, male, Pt Lincoln, S.A., in BM(NH), seen.

Berosus flindersi: Holotype, male, Pt Lincoln, S.A., in BM(NH), seen. Paratype, female, in SAM, seen.

Description (number examined 131)

Length 2.8–4.8 mm. Oval, elytra moderately humped, highest behind middle where it is approximately 1/3 × height at shoulder. Apex of elytron rounded, in some subacute and suggestive of a thick broad spine. Head relatively narrow, black, shiny, metallic. Pronotum black with sides broadly brown, often with small central brown spot or band behind front edge, shiny, metallic. Elytron shiny brown, with striae, punctures and a few spots black. Ventral surface black, appendages brown, except for extreme tips of lapial palps and rugose portion of meso- and metafemur which can range from light-brown to black. Punctures small, dense. Punctures on head strong, regular, well-impressed, most less than 1/2 puncture width apart. Punctures on pronotum similar but slightly less dense. Elytral striae well-impressed. Second stria on elytron 1/4 length of elytron. Punctures in and between striae similar, about same size as on pronotum, strongest laterally, those on extreme humeral angles and between first stria and suture smaller. Mesosternal keel weakly to moderately well-developed, projecting backwards. Metacoxal process sharply produced backwards in midline, lateral lobes raised, sides diverging towards front, small narrowly oval shiny depression in midline. Keel in midline of first abdominal segment weak, reaching only 1/4 to 1/3 of width. Rugose portion of metafemur approximately 1/3 length of femur. Meso- and meta-tibia strongly spined. Apical abdominal segment with small weak notch.

Male: Protarsi four-segmented, first segment moderately expanded.

Remarks

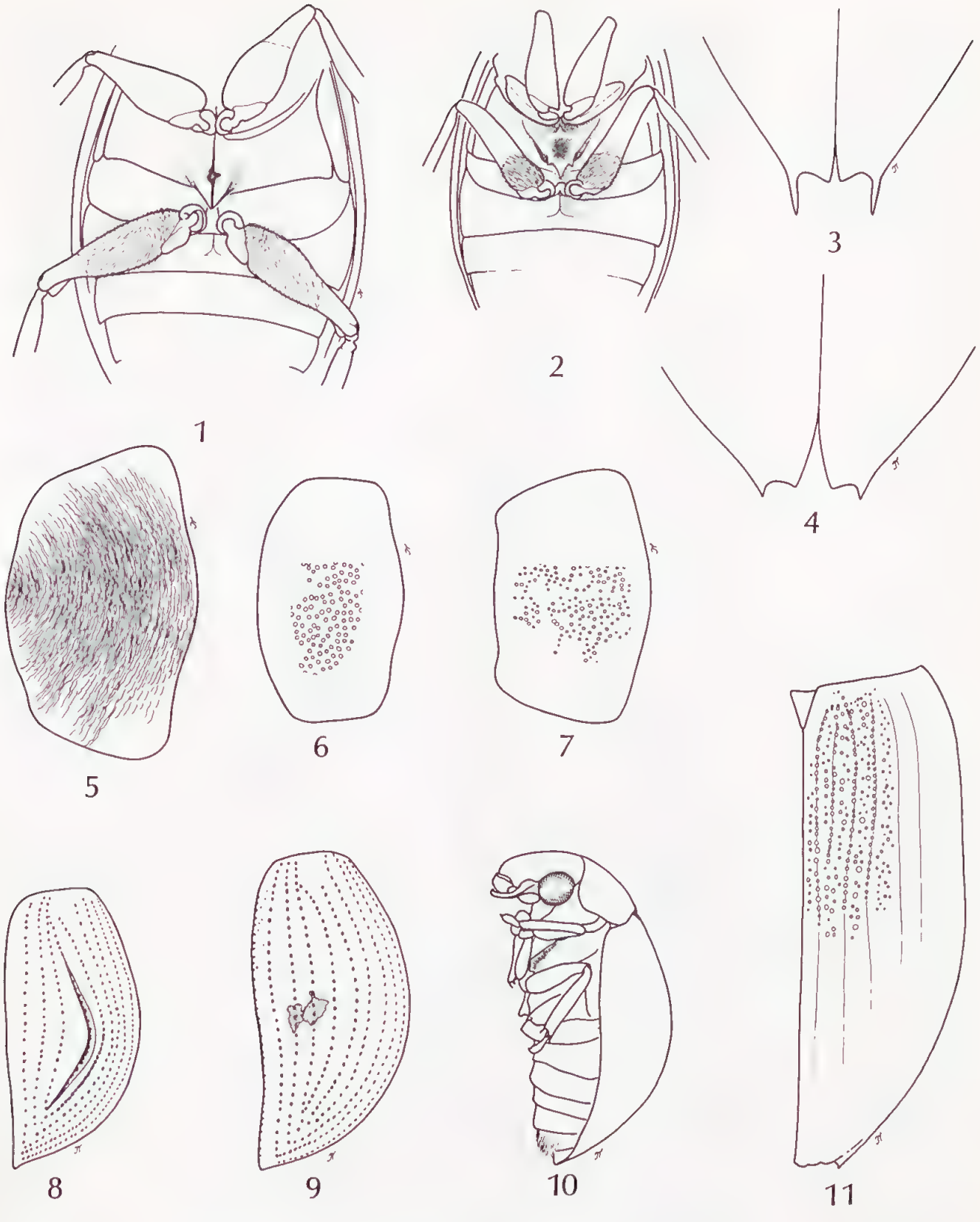
Less common in collections than *B. approximans*. Readily separated from those other *Berosus* with a well-developed mesosternal keel and short second elytral stria by the small area of rugosity on the femora.

Distribution (Fig. 79)

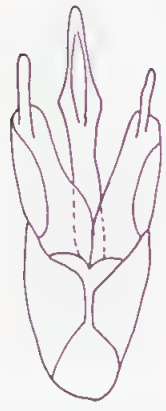
Coastal southern Australia from Perth, W.A. to Sydney, N.S.W., and Tas.

Berosus approximans Fairmaire
(Figs 10, 12, 17)

Berosus approximans Fairmaire, 1879, p. 82.
Berosus ovipennis Fairmaire, 1879, p. 82, syn. nov.



FIGURES 1-11. 1, Midventral region of *B. nicholasi*; 2, midventral region of *B. discolor*; 3, apex of elytra of *B. munitipennis*; 4, ditto, *B. munitipennis*; 5, pronotum of *B. nutans*; 6, pronotum of *B. gibbae* showing punctation on disc; 7, pronotum of *B. arcus* showing punctation on disc; 8, lateral view of elytron of *B. arcus*; 9, lateral view of elytron of *B. involutus*; 10, lateral view of *B. approximans* showing pronotal pillar (shaded); 11, elytron of *B. majusculus* showing punctation of disc.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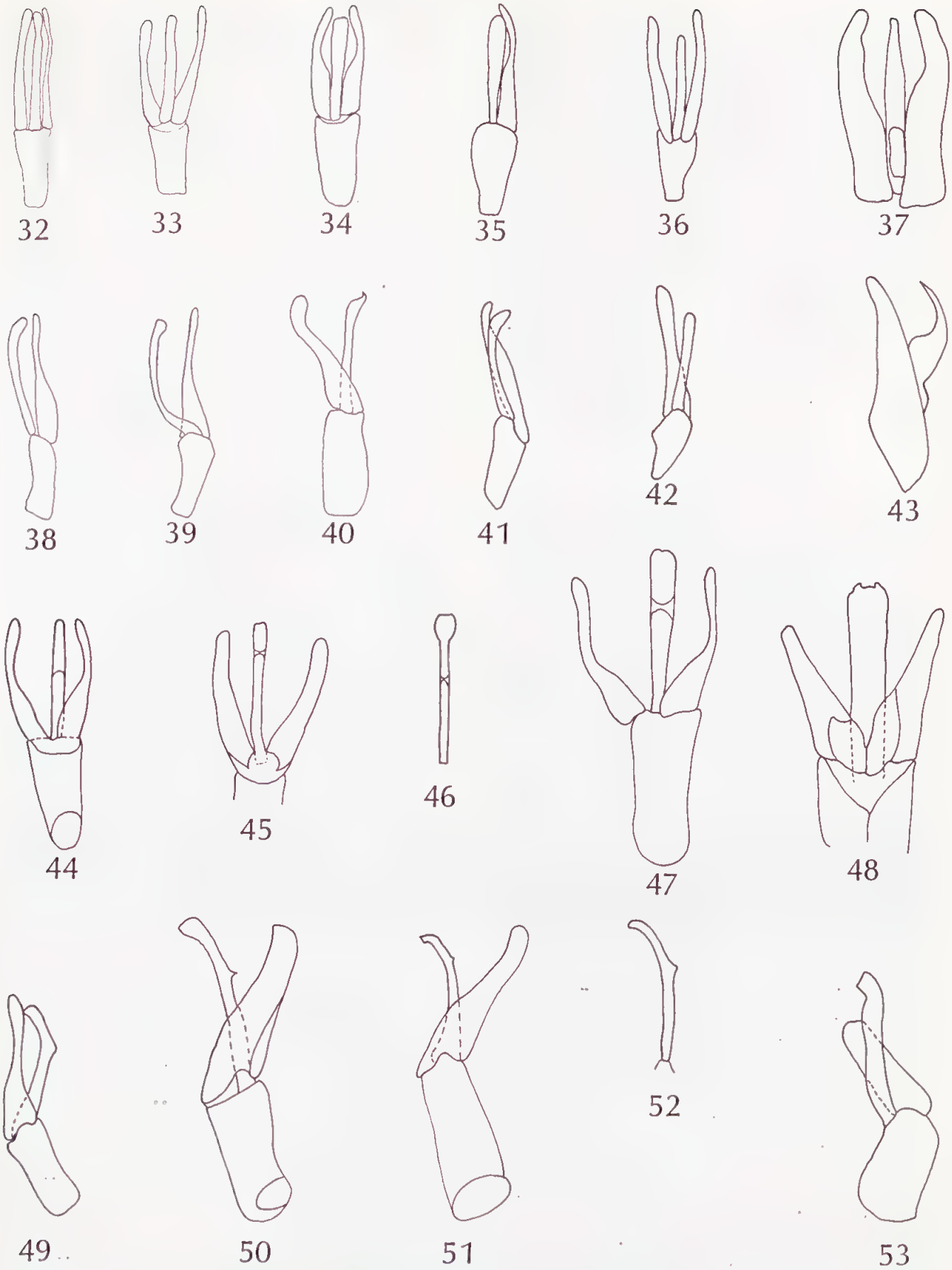
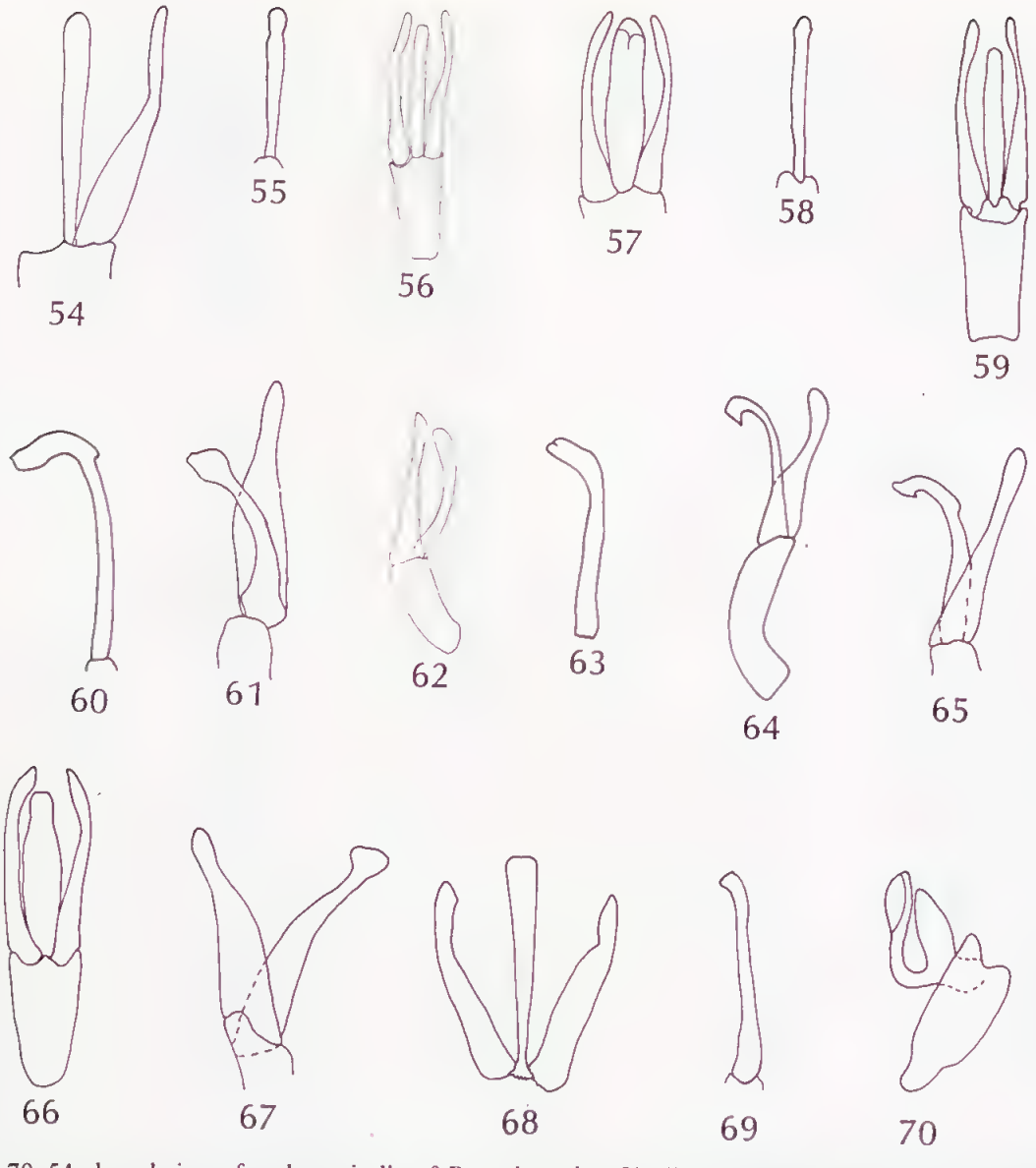
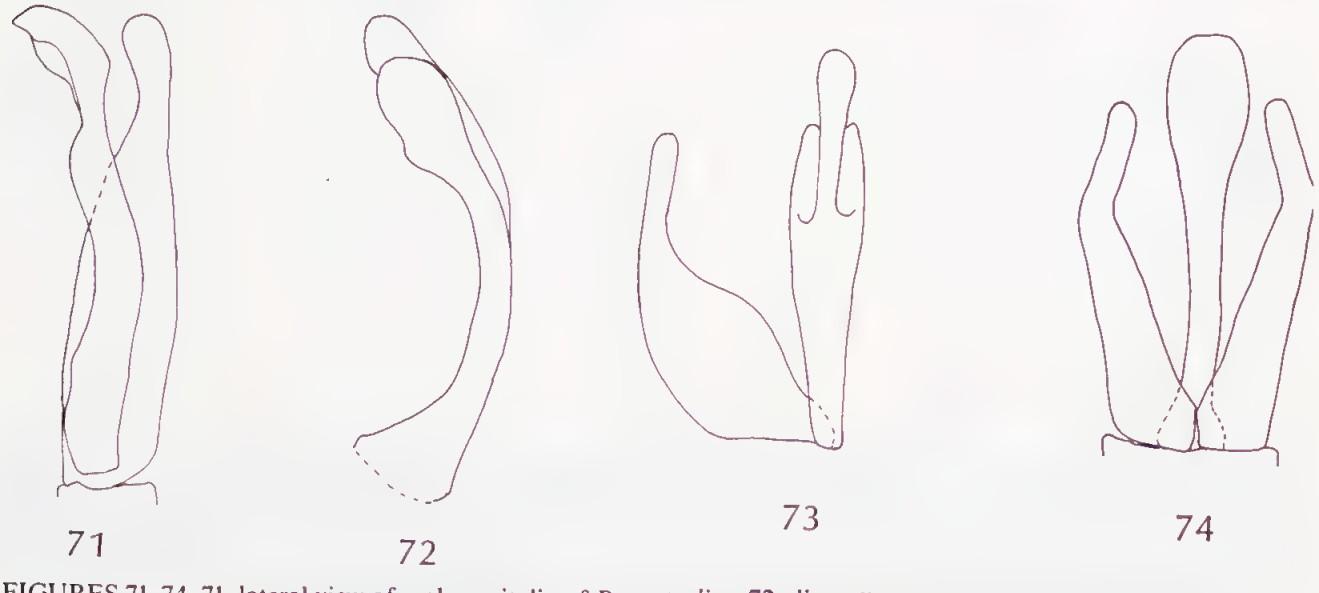
FIGURES 12–31. 12, dorsal view of male genitalia of *B. approximans*; 13, ditto, *B. discolor*; 14, ditto, *B. juxtadiscolor*; 15, ditto, *B. reardoni*; 16, ditto, *B. timmsi*; 17, lateral view of male genitalia of *B. approximans*; 18, ditto,*B. discolor*; 19, ditto, *B. juxtadiscolor*; 20, ditto, *B. reardoni*; 21, ditto, *B. timmsi*; 22, dorsal view of aedeagus and right paramere of *B. duplopunctatus*; 23, ditto, *B. queenslandicus*; 24, dorsal view of aedeagus of *B. arcus*; 25, ditto, *B. niger;* 26, ditto, *B. involutans*; 27, lateral view of aedeagus of *B. duplopunctatus*; 28, ditto, *B. queenslandicus*; 29, ditto *B. arcus*; 30, ditto, *B. niger*; 31, ditto, *B. involutans.*



FIGURES 32–53. 32, dorsal view of male genitalia of *B. dallasi*; 33, ditto, *B. gibbae*; 34, ditto, *B. aquilo*; 35, ditto, *B. vijae*; 36, ditto, *B. subovatus*; 37, *B. trishae*; 38, lateral view of male genitalia of *B. dallasae*; 39, ditto, *B. gibbae*; 40, ditto, *B. aquilo*; 41, ditto, *B. vijae*; 42, ditto, *B. subovatus*; 43, ditto, *B. trishae*; 44, dorsal view of male genitalia of *B. debilipennis* (thin form); 45, ditto, *B. debilipennis* (thick form); 46, ditto, *B. sadieae*; 47, ditto, *B. decipiens*; 48, ditto, *B. pulchellus*; 49, ventral view of male genitalia of *B. debilipennis* (thin form); 50, ditto, *B. sadieae*; 51, *B. debilipennis* (thick form); 52, ditto, *B. decipiens*; 53, ditto, *B. pulchellus*.



FIGURES 54–70. 54, dorsal view of male genitalia of *B. majusculus*; 55, ditto, *B. josephenae*; 56, ditto, *B. amoenus*; 57, ditto, *B. nutans*; 58, ditto, *B. munitipennis*; 59, ditto, *B. macumbensis*; 60, lateral view of male genitalia of *B. majusculus*; 61, ditto, *B. josephenae*; 62, ditto, *B. amoenus*; 63, ditto, *B. nutans*; 64, ditto, *B. munitipennis*; 65, ditto, *B. macumbensis*; 66, dorsal view of male genitalia of *B. nicholasi*; 67, lateral view of male genitalia of *B. veronicae*; 68, dorsal, *B. veronicae*; 69, lateral, *B. nicholasi*; 70, lateral, *B. macropunctatus.*



FIGURES 71–74. 71, lateral view of male genitalia of *B. australiae*; 72, ditto, *B. ralphi*; 73, dorsal view of male genitalia of *B. ralphi*; 74, ditto, *B. australiae.*

Berosus stigmaticollis Fairmaire, 1879, p. 82, syn. nov.
Berosus simulans Blackburn, 1888(1889), p. 832, syn. nov.
Berosus auriceps Blackburn, 1889(1890), p. 447, syn. nov.
Berosus blackburni Zaitz, 1908 p. 358, nom. nov. for *B. auriceps*.

Types
B. approximans. Holotype, male, Peak Downs, N.T. in MNHN, seen.
B. stigmaticollis. Holotype, female, Peak Downs, N.T. in MNHN, seen.
B. ovipennis. Holotype, female, Pt Mackay, in MNHN, seen.
B. auriceps. Holotype, male, Northern Territory, in BM(NH), seen.
B. simulans. Holotype, male, Rivoli Bay, S.A. in SAM, seen.

Description (number examined 134)
Length 3.0–5.2 mm. Narrowly oval, elytra moderately humped, higher behind middle where it is 1/3 higher than at humeral angle. Apex of elytron rounded or produced into a small, widely triangular spine. Head black, shiny, metallic. Pronotum brown with broad central panel darker, dark portion usually not reaching front or rear edges and often with lighter area in midline, shiny. Elytron brown, with striae, punctures and a few spots, black, shiny. Ventral surface black, appendages lighter. Rugose portions of femora variable from light to dark-brown. Punctures on head strong, regular, well-impressed, most less than 1/2 puncture width apart. Punctures on pronotum similarly sized but less dense. Weaker on disc. Elytral striae well-impressed. Second stria on elytron 1/4 length of elytron. Punctures in striae and between them approximately the same size, as strong laterally as on disc. Reticulation of elytron variable, virtually absent in some, in others very strong and almost masking punctures, especially laterally. Ventral surface densely rugose punctate. Mesosternal keel strongly produced downwards forming a pillar. Front edge almost perpendicular to body, ventral edge straight, or concave in some specimens, with the front portion projecting downwards as much or further than rear portion. Lateral lobes of metacoxa raised, bluntly pointed, midline produced backwards in a point, small oval depression in midline devoid of sculpture. Keel in midline of first abdominal segment well-marked, reaching 1/4–3/4 segment. Rugose portion of metafemur 1/2–2/3 length of femur. Meso- and meta-tibiae strongly spined. Apical abdominal segment weakly and widely notched.
Male: Protarsi four-segmented, first segment moderately expanded. Head narrower than in female.

Remarks
A southern species slightly larger than *B. flindersi*. Readily separated from that species by the larger area of rugose sculpture on the femora. The notch on the last abdominal segment is also broader and weaker in *B. approximans*. Differs from *B. juxtadiscolor* and *B. reardoni* from northern Australia by having a smaller amount of rugose sculpture on the femora than in these species, in the generally strongly elytral punctures and in characters of the aedeagus. Its wide distribution, variability in size and in the strength of the dorsal punctation has led to it being described a number of times by earlier authors.

Distribution (Fig. 76)
Southern coastal Australia from Kimberley, W.A., to Rockhampton, Qld.

Berosus reardoni sp. nov.
(Figs 15, 20)

Description (number examined 7)
Length 3.2–4.5 mm. Narrowly oval, elytra moderately humpbacked, highest behind middle where it is 1.4 × height at shoulders. Apex of elytron bluntly pointed. Head shiny, black. Pronotum yellow-brown with two longitudinal black strips adjacent to midline, dark portions not reaching front or hind margin. Elytron yellow-brown with striae and many punctures on head strong, regular, well-impressed, most less than 1/2 a puncture-width apart. Punctures on pronotum moderately dense and strong laterally, weaker and sparser on disc. Dorsal surface weakly to moderately reticulate. Elytral striae well-impressed, less so on disc, second stria on elytron a little less than 1/4 length of elytron. Punctures in striae somewhat larger than those in interstriae, shallower and slightly larger laterally. Mesosternal pillar long, well-developed, ventral edge concave. Ventral surface densely rugose-punctate. Metacoxal process broad, lateral lobes lowered slightly, diverging towards rear, deeply and broadly pitted in centre, weakly triangularly produced backward in midline. Apical abdominal segment notched. Rugose portion of metafemur 2/3 length of femur, that of mesofemur between 1/2–2/3, that of profemur about 1/3 length of femur on hind edge.

Male: Protarsi four segmented. First segment moderately expanded.

Remarks
This northern member of the *approximans* species group closely resembles *B. juxtadiscolor*, but differs in being lighter in colour, particularly the rugose portions of the femora, and in the shape of the aedeagus and parameres.

Distribution (Fig. 75)
Northern N.T.

Types
Holotype male 'Katherine, N.T., at light 9.11.68 J. A. L. Watson', in ANIC.

Berosus juxtadiscolor sp. nov.
(Figs 14, 19)

Description (number examined 18)
Length 3.5–5.0 mm. Narrowly oval. Elytra weakly humpbacked, highest behind middle where it is 1.2 × height at shoulder. Apex of elytron rounded. Head shiny black. Pronotum dark yellow-brown with two central longitudinal stripes darker. Elytron darkish yellow-brown with punctures and striae darker, in many individuals elytron almost completely dark. Ventral surface dark-brown, appendages other than rugose portion of femurs somewhat lighter. Punctures on head strong, regular and well-impressed, most less than 1/2 a puncture-width apart. Punctures on pronotum moderately dense and strong laterally, weaker and sparser on disc. Dorsal surface weakly to moderately reticulate. Elytral striae well-impressed, less so on disc. Second stria on elytron a little less than a 1/4 length of elytron. Punctures in striae slightly larger than those in interstriae. Punctures stronger towards sides. Interstriae not arranged in a single row. Mesosternal pillar long, well-developed, ventral edge slopes downwards towards rear, sharply pointed on ventral rear angle. ventral surface densely but shallowly rugose-punctate. Metacoxal process broad, squarish, lateral lobes weakly lowered, deeply and broadly pitted in centre, triangularly produced backwards in midline. Midline keel in first abdominal segment moderately developed in front half. Apical abdominal segment notched. Rugose portion of metafemur 2/3 length of femur, that of mesofemur a little over 1/2, that of profemur about 1/3 on hind edge.

Male: Protarsi four-segmented. First segment moderately expanded, second segment small; third segment long and thin about length of first and second segment.

Remarks
This species closely resembles *B. reardoni* but has a more complexly shaped paramere and differently shaped aedeagus. It seems to be a darker species than *B. reardoni* which has the rugose portions of the femora the same colour as rest of leg. Only a few specimens of *B. reardoni* are known. A clearer idea of the relationships between these two species must await the collection of further material. The greater extent of rugosity on the legs separates it from the otherwise quite similar *B. discolor*.

Types
Holotype, male, '11°09'S 132°09'E, Black Point, Cobourg, N.T., 15–23 Feb., 1977. T. A. Weir', in ANIC. Paratypes; six, same data as holotype, in ANIC; one, same data as holotype, in CW; two,'Howard Springs, N.T., light 27.i.68, J. A. L. Watson', in ANIC.

Distribution (Fig. 77). At present known only from the coastal areas of the N.T.

Berosus timmsi sp. nov.
(Figs 16, 21)

Description (number examined seven)
Length 3.4–4.0 mm. Oval, elytron weakly humped, highest behind middle where it is approximately 1.2 × height of shoulder. Apex of elytron rounded or weakly truncated. Head black, shiny, metallic. Pronotum yellowish with central panel dark-brown, shiny, metallic. Elytron shiny yellow-brown, with striae, punctures and a few spots black. Ventral surface dark-brown to black, appendages brown except for rugose portions of meso and metafemura which are darker. Punctures on ventral surface moderately large, dense. Punctures on head strong, regular, well-impressed, most at rear of head less than 1/2 puncture-width apart. Punctures on pronotum strong, variable in size particularly laterally, less dense than on head, well-impressed. Elytral striae well-impressed, with strong tendency for the inner edge of striae to be sharper than outer. Second stria on elytron 1/4 length of elytron. Punctures in striae strong and little larger than largest on pronotum. Interstrial punctures small, subobsolete over most of elytron. Mesosternal keel moderately developed, pillar well-developed, concave and denticulate on ventral edge, front and rear projections largest. Metacoxal process projecting backwards in midline, lateral lobes weakly raised, pointed behind, weakly converging towards front, a wide shiny diamond shaped depression in midline. Keel in midline of first abdominal segment moderately strong reaching across most of segment. Rugose portion of metafemur approximately 2/3 length of femur, that on mesofemur approximately 1/2, that on profemur 1/2–1/3 length of femur. Meso- and metatibiae strongly spined. Apical abdominal segment with strong deep wide notch to about 1/2 distance of normally visible portion of segment.

Male: Protarsi four-segmented, first segment strongly expanded. Metafemur with distinct triangular bulge in lower hind margin midway along rugose portion.

Female: Metafemur of some specimens show slight thickening in same area as in male.

Remarks
This species resembles the more widespread *B. juxtadiscolor* with which it is sympatric, but differs from it (and all other *Berosus*) by the shape

of the male metafemur which is reminiscent of the femora of some male Dytiscids of the genus *Antiporus*. The variably-sized pronotal punctures and very small interstrial punctures also separate it from *B. juxtadiscolor* and *B. reardoni*.

Distribution (Fig. 82)
Known only from the type locality at the tip of Cape York, Qld.

Types
Holotype, male, 'Bamaga, Qld, 29/6/83, Timms', in SAM. Seven paratypes, same data as holotype: one male, one female, in ANIC; one male, three females in CW.

Berosus niger sp. nov.
(Figs 25, 30)

Description (number examined seven)
Length 3.3–4.0 mm. Oval. Elytra parallel-sided, humpbacked, highest just behind the middle where it is 1.5 × the height at the shoulders. Apex of elytron not spined. Black, portions of elytral interstriae in apical half and appendages of head, dark yellow-brown. Head and pronotum with large, dense, moderately-impressed punctures. Pronotum with some scattered much smaller punctures in spaces between larger punctures. Strial punctures large, shallow. Interstrial punctures weak, ill-defined, lacking laterally and apically. Second striae approximately 1/2 length of elytron. Spaces between elytral striae 8 and 9, 9 and 10, and 10 and 11 greater in the middle of elytron than elsewhere. Elytral striae 1, 3, 4, 5, 6, 7, 8 and 11 ridged, pronouncedly so on stria 8. The strongly-ridged stria 8 bends sharply towards apex where it is about 90° to the edge of elytron when viewed laterally. Ventral surface rugose-punctate. Mesosternal pillar long, ventral edge weakly concave, anterior ventral angle with very small spine. Metacoxal process broad, squarish, with large pit in midline, projecting backwards sharply in midline, continued forwards in midline by well-marked ridge. Midline keel on first abdominal segment strongly raised for whole length of segment. Apical abdominal segment moderately notched, lateral flanges moderately developed. Rugose portion of metafemur reaching 1/2 way on posterior edge and a little less on anterior edge, rugose portion of mesofemur about 1/3 length of femur, that on profemur very small.

Male: Protarsi four-segmented. Basal segments not expanded, first segment somewhat longer than second and third which are subequal in size.

Remarks
A north-eastern highlands species. Readily separated from similar species by the almost completely black colour and the form of the lateral striae on the elytron.

Distribution (Fig. 75)
Mountainous areas on east coast north of Townsville, Qld.

Types
Holotype, male, 'Star Valley lookout c. 5 km W of Paluma Qld, 3.vii.67, at light, J. G. Brooks', in ANIC. Paratypes: one, '13.6M up Whitfield Ra. Rd., Cairns, 3/11/70, J. G. Brooks', in ANIC; one, 'Tinaroo Ck., N.Q. 1/73 A.W.H.', in ANIC; one 'Mt. Spec. N.Q. 11/73 G.B.', in ANIC; one, '7.8M. NW Paluma, NQ 5.11.73 J. G. Brooks, in ANIC; two, 'Australia N.Qld. Windsor Tableland via Mt. Carbine 11–12 Jan 1980 R. I. Store', in QPI.

Berosus involutus (W. MacLeay)
(Figs 9, 26, 31)

Hygrotrophus involutus W. MacLeay, 1873 p. 132.

Types
There are four specimens from Gayndah, Qld in ANIC (on loan from the MacLeay Museum), labelled 'Syntypes'. Two of these are *B. pulchellus* and two *B. approximans*. The original description does not indicate how many specimens MacLeay had before him. Apart from the locality there is little to connect these insects with a type series of *B. involutus*. Two specimens labelled '*Hygrotrophus involutus* M. L. W. Gayndah', mounted on the same card, are in the AM labelled 'Holotype' and numbered K19531. They agree well with the brief description and belong to the species that subsequent workers such as Blackburn and Lea have identified as *B. involutus*. I therefore herein designate the left-hand specimen as the lectotype of *Hygrotrophus involutus* W. MacLeay, 1873.

Description (number examined 475)
Length 3.5–4.5 mm. Oval, elytra humpbacked, highest just behind middle where about 1.5 × height at shoulder. Apex of elytron rounded. Head and most of pronotum black, with metallic sheen. Front and side margins of pronotum yellow-brown, occasionally lacking, elytron brown, punctures and striae and variable number of markings black. Ventral surface black. Appendages light-brown, tip of labial palpi and rugose portions of meso- and metafemora black. Head and pronotum with dense large evenly-sized nearly confluent punctures. Interstrial punctures on elytron large and well-marked, almost touching, those towards sides and humeral angles larger and squarer. Interstrial puncture small, shallow, strongest on disc, obsolete laterally. Second stria approximately half length of

elytron. Distance between striae seven and eight and eight and nine often slightly greater in middle, other striae approximately equidistant from each other. Ventral surface rugose-punctate. Mesosternal keel in form of a long pillar, with a small downward point at front edge. Metacoxal process broad, sides raised, subparallel, deeply and broadly pitted in middle, pit devoid of sculpture, projecting backward sharply for short distance in midline, lobed. Midline keel of first abdominal segment strongly raised for whole width of segment. Apical abdominal segment broadly notched with well-developed lateral flanges, a pair of very small tubercules on edge of middle of notch. Rugose portion of metafemur dark, reaching 1/2–2/3 along femur on anterior edge, not as far on posterior edge.

Male: Protarsi four-segmented. Segments not expanded, basal three subequal in size.

Remarks

A common species in clear streams and pools in the Great Dividing Range from Vic. to north Qld. Many specimens from the higher areas of Vic. and N.S.W. are darker in colour and lack the distinctive yellow margins on the pronotum. Separated from the two related species, *B. niger* and *B. arcus*, by the lack of strongly raised and bowed seventh elytral stria. It is also noticeably larger than *B. arcus* and is different in colour from *B. niger*. It is only in the northern portion of its range that *B. involutus* is sympatric with these two similar species.

Distribution (Fig. 76)

Coastal eastern Australia from southern Cape York to south-eastern Vic.

Berosus arcus sp. nov.
(Figs 8, 24, 29)

Description (number examined 149)

Length 1.5–3.4 mm. Oval, elytra humpbacked, highest just behind middle where about 1.2 × height at shoulder. Apex of elytron without spines. Black, elytral interstriae, edges of pronotum apart from central portion of rear margin, appendages apart from tip of labial palpi and rugose portions of meso and metafemora yellow-brown. Head and pronotum with dense strong evenly-sized and spaced punctures. Strial punctures on elytron large, almost touching. Interstrial punctures large but very shallow, stronger on disc than laterally. Second stria on elytron approximately 1/2 length of elytron. Distance between striae eight and nine greatly enlarged in middle to about twice distance between striae nine and ten, which is also slightly enlarged in middle. Stria eight moderately carinate in middle section where distance from stria nine greatest. Ventral surface rugose-punctate. Mesosternal keel in wide pillar, anterior ventral angle of pillar sharply produced downward into small sharp point. Metacoxal process broad, squarish, sides raised, subparallel, deeply and widely pitted in midline, projecting backwards sharply in midline. Midline keel on first abdominal segment strongly raised for whole length of segment. Apical abdominal segment broadly notched with well-developed lateral flanges. Rugose portion of metafemur reaching nearly 2/3 along posterior edge of femur and 1/3 on anterior edge, that on mesofemur reaching a little over 1/2 length of femur on posterior edge, 1/3 on anterior edge, that on profemur 1/3 on posterior edge and less than 1/4 on anterior edge.

Male: Protarsi four-segmented, basal three segments subequal in size.

Remarks

A northern species confined to the streams and riverside pools of the ranges around and to the north of the Atherton Tableland. Smaller than *B. involutus* and *B. niger* and readily separated from them by colour and the form of the eighth elytral stria.

Distribution (Fig. 79)

Ranges of southern Cape York and Atherton Tableland, Qld.

Types

Holotype, male, '5 mi. N. Bloomfield Rn., N.Q. 7–9. May 1970 S. R. Curtis', in ANIC. Paratypes, 11 same data as Holotype, in ANIC; one same data, in CW.

Berosus trishae sp. nov.
(Figs 37, 43)

Description (number examined 39)

Length 2.4–4.5 mm. Oval. Elytra parallel-sided, humpbacked, highest just behind middle where it is 1.2 × higher than at shoulders. Apex of elytron rounded. Yellow-brown, head, three rough broad longitudinal patches on pronotum, about a dozen small patches on elytron and vague areas of ventral surface darker. Head and pronotum moderately covered with large strong punctures. A single even row of slightly smaller punctures along front and rear edges of pronotum. Strial punctures on elytron very large, almost confluent, strongest laterally where they are almost square. Interstrial areas shiny lacking punctures except apically in interstria 3. Second elytral stria a little more than 1/2 length of elytron. Interstrial areas raised somewhat towards apex of elytron. Ventral surface moderately punctate. Mesosternal keel produced in robust pillar, ventral edge of pillar convex. Metacoxal process very broad, parallel sided, central portion with wide pit, lateral lobes project downwards at about 35°, narrowly and triangularly produced backwards in

midline. Midline keel on first abdominal segment strongly raised for whole length of segment. Apical abdominal segment widely and deeply notched with well-developed lateral flanges. Rugose portion of metafemur about 2/3 length of femur, that on mesofemur 1/2–2/3, and that on profemur about 1/2 length of femur.

Male: Protarsi four-segmented, basal segments not expanded.

Remarks

A northern species. Separated from the quite similar *B. quadrapunctatus* by the greater extent of rugose sculpture on the femura and characters of the aedeagus. The sculpture on the head is a little rougher than in *B. quadrapunctatus* and the punctures on pronotum and elytra are smaller. Although this size difference is clearly evident in direct comparisons of most specimens, I have been unable to quantify it to enable the character to be used to separate the species. Most specimens are < 3.5 mm long but a female from Charters Towers, Qld., in NSWD, is considerably larger at 4.5 mm. I can detect no other difference from N.T. specimens.

Distribution (Fig 80)

Darwin area, N.T., Atherton Tableland and, Charters Towers Qld.

Types

Holotype, female, 'N.T. Lake Bennett area c. 25 km S.E. of Manton Dam 29–30 Dec. 1979, M. B. Malipatil', in NTM. Paratypes; 20, 'N.T., Ck. in Holmes Jungle 13.1.1980 M. Malapatil', in NTM, two same data in CW.

Berosus macropunctatus sp. nov.
(Fig. 70)

Description (number examined two)

Length 3.0–3.6 mm. Oval. Sides of elytra subparallel, humpbacked, highest about 1/3 distance from apex of elytra where it is about 1.2 × height at shoulders. Apex of elytron squarish. Yellow-brown, head and pronotum black except for narrow yellowish band on lateral and hind edges, elytron with scattered darker patches. Head and pronotum strongly rugose-punctate. Strial punctures on elytron large, larger and squarish towards sides. Interstrial areas shiny, impunctate except for a row of very small setae-bearing punctures towards apex of third interstria. Lateral three interstrial areas raised into weak ridges. Interstrial areas at extreme apex weakly raised. Ventral surface strongly rugose-punctate. Mesosternal keel produced into a narrow pillar. Ventral edge of pillar slopes downwards towards rear and has a small downward pointing spine on ventral anterior angle. Metacoxal process very broad, lateral lobes parallel sided, rather narrow, separated by wide pit in centre of process, open towards rear, lateral lobes slope downwards at about 20°, broadly triangularly produced backwards in midline. Midline keel of first abdominal segment strongly developed over whole length of segment, ventral edge serrate, apical abdominal segment deeply and widely notched with well-developed lateral flanges. Rugose portion of metafemur 3/4 length of femur, that of mesofemur a little less than 3/4, that on profemur 1/2 length of femur.

Male: Protarsi four-segmented, basal segments not expanded.

Remarks

A distinctive species readily separated from *B. trishae* and *B. quadrapunctatus* by the strongly rugose-punctate black head and pronotum.

Distribution (Fig. 76) (N.T. type localities only.)

Types

Holotype, male, 'Burrell's Ck Stuart H'way N.T. 24 Nov, 1972 D.H. Colless', in ANIC. Paratype, one, 13°15'S, 131°06'E, Adelaide River, N.T., 16.x.72, M. S. Upton', in ANIC.

Berosus quadrapunctatus sp. nov.

Description (number examined 4)

Length 3.2–3.9 mm. Elytra humpbacked, highest just behind middle where it is 1.3 × height at shoulders. Apex of elytron rounded, weakly flanged. Yellow-brown with head black and three broad vague longitudinal patches on pronotum, scattered patches on elytron and patches in the midline ventrally, darker, shiny. Head and pronotum moderately covered with large well-impressed punctures. Elytron with strial punctures very strong, particularly laterally where they are square. Punctures in adjacent lateral striae almost touch. Interstrial areas shiny, lacking punctures except for some minute setae-bearing ones towards apex in interstria three. Second elytral stria reaches a little over 1/2 length of elytron. Interstrial areas towards extreme apex become strongly raised. Ventral surface covered with numerous large but separate rugose punctures. Mesosternal keel produced into a narrow pillar, concave on ventral edge. Metacoxal process very broad, parallel-sided with large pit in midline, narrowly triangular, projecting backwards in midline, lateral lobes slope downwards at about 45°. Keel on first abdominal segment strongly raised for whole length of segment, serrate on ventral edge. Apical abdominal segment broadly notched, with

well-developed lateral flanges. Rugose portion of metafemur a little over 1/2 length of femur, that on mesofemur a little under 1/2, that on profemur 1/3 length of femur.

Male: Protarsi four-segmented, basal segments not expanded.

Remarks

A little known species differing from *B. trishae* by the less well-developed rugose sculpture on the femora and in the more uniform sculpture on head. A female specimen from Charters Towers, Qld.,(in NSWDA) may belong to this species. It is longer (4.5 mm), the rugose portion on the femora is a little greater, the sculpture on the head is rougher with some scattered very small punctures as in *B. trishae*. In these characters it is intermediate between *B. trishae* and *B. quadrapunctatus*.

Distribution (Fig. 80)

Known only from the type series from McArthur River, N.T.

Types

Holotype, male, 'McArthur River, 16°47'S 135°45'E, 14 km S by W of Cape Crawford, N.T., 25 Oct. 1975 M. S. Upton, in ANIC. Paratypes, three, same data as holotype, in ANIC.

Berosus queenslandicus Blackburn
(Figs 23, 28)

Berosus queenslandicus Blackburn, 1898, p. 223.
Berosus quartinus d'Orchymont, 1943, p. 6, syn. nov.

Types

B. queenslandicus, holotype female, Qld., in BM(NH), seen. Paratype, female damaged, in SAM, seen. *B. quartinus*, holotype, male, and paratype, in MNHN.

Description (number examined 42)

Length 4.2–6.3 mm. Oval, elytra humpbacked, approximately twice as high just behind middle as at shoulder. Apex of elytron rounded. Head black with metallic sheen. Pronotum shiny, widely black or dark-brown in midline, brown at sides. Elytron shiny, brown with dark-brown to black mottlings. Ventral surface mottled dark-brown and black, appendages brown, apical segment of labial palpi darker, rugose portions of meso- and meta femora dark-brown to black. Punctures on head large, subequal except for clypeal margin where they are smaller, those on disc separated by about 1/2 their width, a few scattered very small punctures in some specimens. Head with small midline ridge on back, sometime lacking. Punctures on pronotum as on head, closer together laterally. Punctures in elytral striae well-marked almost confluent in any one stria, stronger towards front. Interstrial areas virtually impunctate except for small area of large punctures on humeral angles. In some specimens some very shallow small punctures can be seen in some lights in interstriae on disc. Striae weakly impressed on disc, stronger laterally and apically. Second stria on elytron reaching 2/3 length of elytron. Striae approximately equidistant from each other. Ventral surface rugose-punctate. Mesosternal keel in form of high narrow pillar, ventral edge concave, keel on midline of mesosternum forward of pillar weak. Midline keel on first abdominal segment well-marked, reaching almost completely across segment but weakening rapidly towards rear. Metacoxal process broad with well-marked lateral lobes, sides subparallel, with depressed shiny impunctate area in midline. Rugose portion of metafemur about 1/3 length of femur, ending in relatively straight edge across most of femur, that on metafemur 1/3, that on profemur 1/3 length of femur on hind edge. Apical abdominal segment deeply notched in midline with lateral flanges to notch.

Male: Protarsi four-segmented, basal segments subequal not expanded.

Remarks

Separated from the superficially similar *B. duplopunctatus* by the slightly larger and differently shaped rugose portions on femora, the virtual lack of smaller punctures on head and pronotum and the virtual lack of interstrial punctures. Some specimens have some minute punctures in between the large ones on the head and to a lesser extent on the pronotum, but these are much smaller and fewer than those in *B. duplopunctatus*. Synonomy based on d'Orchmont's description and illustration of male genitalia.

Distribution (Fig. 78)

Coastal south-eastern Australia from Caloundra, Qld., to Adelaide, S.A.

Berosus duplopunctatus Blackburn
(Figs 22, 27)

Berosus duplopunctatus Blackburn, 1888 (1889), p. 828.

Types

Holotype, female, Pt Lincoln, S.A., in BM(NH), seen. Paratype, female, Pt Lincoln, S.A. in SAM, seen.

Description (number examined 109)

Length 4.5–6.4 mm. Oval, elytra humpbacked, at highest point just behind middle about 1.5 × height

at shoulder. Apex of elytron rounded. Head relatively wide, black, shiny with metallic sheen. Midline of pronotum black, sides brown. Elytron predominantly brown with punctures outlined in black plus some black spots, extent of black varies between specimens and is the dominant colour in many. Ventral surface black, appendages light-brown, tip of apical segment of labial palpi black, rugose portions of meso- and metafemora black. Head densely punctate with both large and small punctures. Pronotum with large and small punctures, less dense than on head. Punctures in elytral striae well-impressed, almost confluent, stronger towards front, about as strong on disc as laterally. Interstrial punctures shallow, small, numerous, scattered, very weak laterally. Striae moderately impressed, slightly weaker on disc. Striae approximately equidistant apart. Second stria on elytron reaches to 3/4 length of elytron. Humeral angle of elytron serrate due to large punctures close to edge. Ventral surface strongly rugose-punctate. Mesosternal keel in form of high narrow pillar, weakly concave on ventral edge, keel in front of pillar weak. Midline keel on first abdominal segment well-marked in front half, weaker in hind half of segment. Apical abdominal segment deeply notched, notch with lateral flanges. Metacoxal process with well marked lateral lobes, converging towards rear and with small shiny impunctate depressed area in midline. Rugose portion of mesofemur about 1/3 length of femur on hind edge, about 1/4 length on front edge of femur, that on hind edge of metafemur 1/4, that on profemur 1/4 length of femur.

Male: Frotarsi four-segmented, basal three subequal not expanded.

Remarks
Readily separated from the superficially similar *B. queenslandicus* by the punctate elytral interstriae and the presence of small punctures on the pronotum.

Distribution (Fig. 80)
Coastal eastern Australia from Sydney, N.S.W. to Kangaroo Island, S.A.; Tas.

Berosus nutans (W. MacLeay)
(Figs 5, 57, 63)

Hygrotrophus nutans W. MacLeay, 1873, p. 132.
Berosus pallidulus Fairmaire, 1879, p. 81, syn. after Blackburn, 1898, p. 222.

Types
Two syntypes labelled 'Gayndah' and mounted on the same card are in the ANIC. The left-hand side specimen, a female, is here designated as lectotype.

Description (number examined 440)
Length 4.2–8.8 mm. Elongate oval, not humpbacked. Apex of elytron rounded or obliquely truncated. Dorsal surface brown with vague darker markings particularly on head and pronotum. Elytron with striae darker. Ventral surface dark-brown to black, appendages brown to dark-brown except for darker tip of labial palpi. Apex of abdomen occasionally brown. Punctures on head well-marked, weaker towards front, transversely elongate. Sculpture on pronotum consists of a close network of fine transverse grooves which cover most of the surface, all but obscuring punctures which themselves tend to be transversely elongate as on head. A fine reticulation is also present on some specimens. Scutellum sculptured as pronotum. Elytron with striae lacking or only weakly impressed, their position often outlined by rows of small transversely expanded, darkly pigmented spots. Elytron densely and evenly covered with short rather stout setae, each seta arising from a small shallow transverse groove. Ventral surface shallowly rugose-punctate with small setae arising from each puncture. Mesosternum with weak keel in midline, extended quite strongly backwards between meso-coxae. Midline of first abdominal segment with moderate keel in front 1/4. Metacoxal process raised, sharply triangular with elongate oval area in midline devoid of sculpture. Rugose portion of metafemur 3/4 length of femur, that of mesofemur 2/3, that of profemur 1/2 length of femur.

Male: Protarsi four-segmented, basal segment expanded, about as long as second and third segment combined, second segment expanded, same length as simple third segment.

Remarks
A common and widespread inland species, readily recognised by the unique sculpture of the pronotum.

Distribution (Fig. 78)
Coastal and southern inland Australia.

Berosus pulchellus W. S. Macleay
(Figs 48, 53)

Berosus pulchellus W. S. Macleay, 1825, p. 35.
Hygrotrophus devisi Blackburn, 1898, p. 225, syn. after d'Orchymont 1943, p. 421.

Types
B. pulchellus, Java, location unknown. *B. devisi*, holotype, ? female, Qld., in BM(NH), seen.

Description (number examined 233)
Length 2.8–4.8 mm. Elongate oval, elytra not humpbacked. Apex of elytron rounded. Head

black, shiny. Pronotum light-brown with front edge narrowly black and usually with wide central panel black, black area not reaching rear border and often with portion of midline narrowly light-brown. Elytral striae often darker. Ventral surface black, appendages light-brown except extreme apex of labial palpi which is darker. Head evenly punctate with moderately dense small punctures, punctures somewhat weaker towards front. Pronotum moderately and evenly covered with small punctures. Elytron strongly and evenly covered with similarly sized punctures, each puncture with a well-marked seta. Elytral striae lacking or very weakly impressed. Punctures in elytral striae same size as interstrial punctures and difficult to distinguish from them. Ventral surface evenly, shallowly rugose-punctate. Midline of prosternum with weak but well-marked keel, weakly projecting backwards between mesocoxae. Midline of first abdominal segment weakly raised in front half. Metacoxal process bluntly triangular, raised, midline with narrow oval area devoid of punctures. Apical abdominal segment deeply notched. Rugose portions of meta and mesofemora 3/4 length of femura, that on profemur 2/3–3/4 length of femur.

Male: Protarsi four-segmented, basal two segments moderately expanded, basal segment about twice length of second which is about same length as third.

Remarks
This widespread and common species is readily separated from all other Australian *Berosus* by the small size, black head and virtual lack of elytral striae. It is most commonly collected from the sandy pools formed during the dry season in the beds of the major northern and eastern river systems. It has recently been collected in numbers in sewerage settlement pits at Whyalla, S.A., an unusual habitat and a long way from its normal range.

Distribution (Fig. 82)
Tropical Australia; Whyalla, S.A.; Asia.

Berosus dallasae sp. nov.
(Figs 32, 38, 70)

Description (number examined 80)
Length 3.8–6.8 mm. Elongate oval. Elytra not humpbacked. Head and pronotum shiny, elytron rugosely reticulate. Apex of elytron produced into two spines, outer one usually strongly and widely developed, inner often small or even vestigal. Dorsal surface light yellow-brown, rough patches on head, pronotum and elytron darker, elytron stria darker. Ventral surface dark-brown, appendages lighter, tip of lapial palpi dark. Head evenly and strongly punctate, punctures much larger than eye facet, much weaker towards front. Pronotum evenly punctate with large strong regular punctures except for some smaller areas along front and rear margin. Punctures on disc have a tendency to become longitudinally elongate. Elytral striae strongly impressed. Stria 2 with punctures a little smaller than those on pronotum and about twice size of those in adjacent interstriae. Interstrial punctures evenly, densely but shallowly impressed over whole elytron, each puncture bearing a small seta. Ventral surface rugose-punctate. Midline of mesosternum weakly and broadly carinate, moderately projected backwards. Midline of first abdominal segment weakly carinate in front 1/4. Metacoxal process broadly triangular, midline weakly carinate in front of a small diamond-shaped area in centre, devoid of sculpture and bounded on front sides by weak edges. Rugose portion of metafemur 3/4 length of femur, that on mesofemur 2/3–3/4 that on profemur 1/2–2/3 length of femur.

Male: Protarsi four-segmented. Basal two segments moderately expanded, first segment about 1.5 × length of second which is a little larger than the narrow third segment.

Remarks
This widespread species of northern Australia is readily separated from the two other, equally widespread, species with setose elytral punctures, by the lack of strongly transversely elongate pronotal punctures (from *B. nutans*), and lack of a black head (from *B. pulchellus*).

Distribution (Fig. 75)
Tropical Australia.

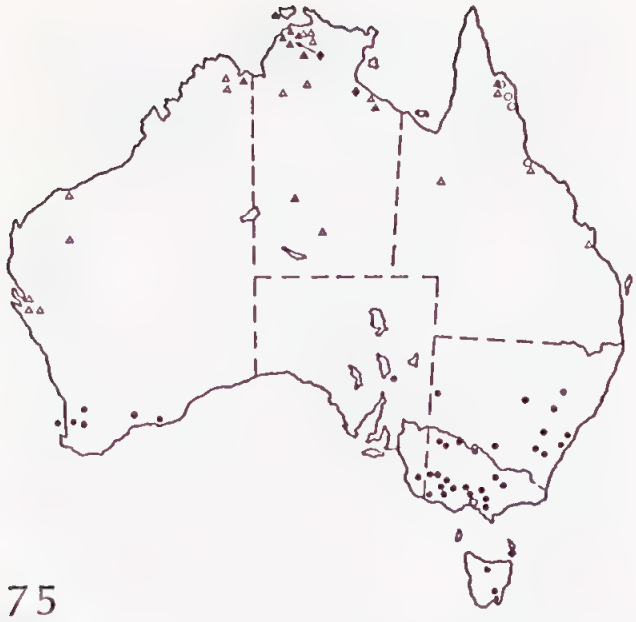
Types
Holotype, male, '1 km N. of Millstream, W.A. (21°35'S 177°04'E), 9–10.iv.1975, M. S. Upton', in ANIC. Paratypes, nine same data as holotype, in ANIC; one same data as holotype, in CW.

Berosus macumbensis Blackburn
(Figs 59, 65)

Berosus macumbensis Blackburn, 1896, p. 259.

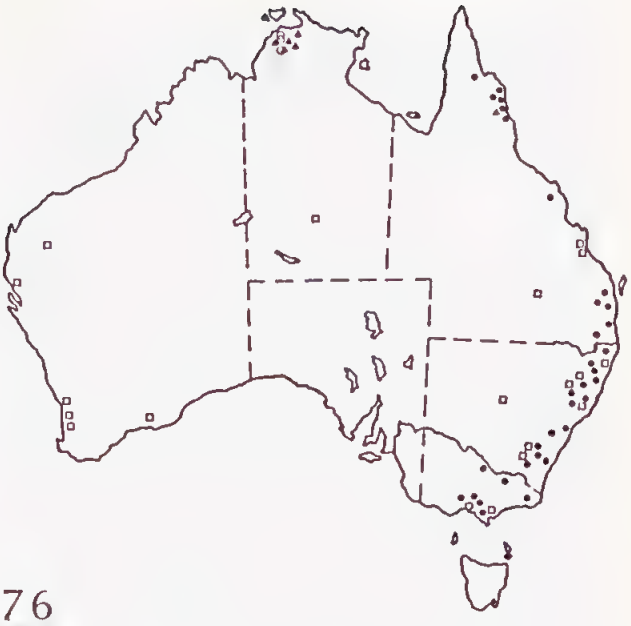
Types
Holotype, male, Macumba Creek, S.A. in BM(NH), seen.

Description (number examined 150)
Length 5.6–7.8 mm. Elongate oval, not humpbacked. Apex of elytron with two spines, the inner usually small and the outer as long as the distance between the two spines. Elytra shiny. Dorsal surface light brown to brown with dark mottlings. Elytral striae and punctures on disc darker. Ventral surface dark-brown to black. Appendages brown except for extreme tip of labial palpi which



75

- ● B. majusculus
- ▲ B. vijae
- △ B. dallasae
- ○ B. niger
- ♦ B. reardoni



76

- ● B. involutus
- ○ B. macropunctatus
- ▲ B. josephenae
- □ B. approximans

77

- ● B. australiae
- ▲ B. juxtadiscolor
- ■ B. ralphi

78

- ● B. nutans
- ▲ B. gibbae
- △ B. decipiens
- ◊ B. queenslandicus

FIGURES 75–78. Distribution maps for Australian *Berosus* spp.

79

- B. arcus
- B. discolor
- B. sadiae
- B. aquilo
- B. nicholasi

80

- B. debilipennis
- B. duplopunctatus
- B. quadropunctatus
- B. trishae

81

- B. munitipennis
- B. macumbensis
- B. veronicae
- B. subovatus

82

- B. pulchellus
- B. aemoenus
- B. timmsi

FIGURES 79–82. Distribution maps for Australian *Berosus* spp. (cont.).

is darker. Head strongly and evenly punctate except towards front where punctures are considerably smaller and weaker. Punctures on pronotum uneven in size and often with a rather patchy distribution. A row of very small punctures along front and rear margins. Elytral striae weakly impressed, for the most part reduced to a row of well-impressed punctures about the size of the larger punctures on pronotum. Interstrial punctures on disc markedly smaller than those on sides of elytra; in no case is there a tendency for interstrial punctures to form a single row. Interstrial punctures on disc tend to be uneven in size. Underside densely rugose-punctate. Midline of mesosternum with weak rather rounded keel, projecting a little distance backwards. Midline of first abdominal segment with little or no keel. Metacoxal process raised, triangular, a narrow diamond or oval-shaped area devoid of sculpture in the midline. Rugose portion of metafemur 1/2 to 2/3 length of femur, that on mesofemur a little over 1/2 and on profemur a 1/3 to a 1/2 length of femur.

Male: Protarsi four-segmented, basal two segments expanded, basal segment larger than second, second and third segment subequal in length.

Remarks

A widespread inland species readily recognized from the other large *Berosus* by the pattern of punctation on the elytra, where the outer punctures are much stronger than the inner punctures.

Distribution (Fig. 81)

Inland Australia.

Berosus munitipennis Blackburn
(Figs 3, 58, 64)

Berosus munitipennis Blackburn, 1895, p. 30.

Types

Holotype, ?male, Lake Callabonna, S.A., in BM(NH), seen.

Description (number examined 48)

Length 4.8–6.6 mm. Elongate oval, not humpbacked. Apex of elytron with very long narrow outer spine and short inner spine, outer usually longer than distance between spine bases. Light-brown, pronotum and head slightly darker than elytra. Suture lines and some punctures usually black on elytron disc. Ventral surface dark-brown to black, appendages brown, tip of labial palpi darker. Head moderately to quite densely covered with punctures, large and well-marked in basal half, smaller towards front. Elytron shiny or with weak to moderate reticulation. Pronotum sparsely or moderately and rather unevenly covered with variably sized, well-marked punctures, front and rear margins with only a few shallow small punctures. Elytral striae weakly to moderately impressed, often reduced over much of disc to a row of punctures. Serial punctures about same size as larger ones on pronotum. Interstrial punctures sparse, shallow, lacking completely over much of elytra in some specimens, where present tend to be arranged in single row. Second elytrae stria less than 1/4 length of elytron. Ventral surface shallowly rugose punctate. Midline of mesosternum weakly carinate, weakly extended backward. Midline of first abdominal segment weakly carinate in basal 1/2 or 1/4. Metacoxal process triangularly-raised, with patch in midline without sculpture, patch bounded at rear by a slight V-shaped ridge extended backwards in midline to tip of process. Rugose portion of metafemur 1/3–2/3 length of femur, that of mesofemur 1/4–1/2, that on profemur 1/3 length of femur along ventral edge.

Male: Basal two segments of protarsi moderately expanded. First segment about 2 × length of second, which is about the same length as the third.

Remarks

An inland species readily recognized by the long, thin, outer elytral spines and virtual lack of an inner one, and the weak development of sculpture on the elytra. This latter character tends to be more marked in central and northern specimens compared with those from Vic. The contrast of the pale upper side and black ventral surface in most specimens is quite striking. The extent of rugosity on the femora is particularly variable in this species.

Distribution (Fig. 81)

Inland Australia south of Barrow Creek, N.T.

Berosus amoenus sp. nov.
(Figs 56, 62)

Distribution (number examined nine)

Length 3.3–4.5 mm. Elongate oval. Weakly reticulate in some specimens. Elytra not humpbacked. Apex of elytron truncated, spines vestigial. Dorsal surface dark-brown to black, edges of pronotum and elytron yellow-brown, sides of elytron with three pale patches extending inwards from sides, the apical ones more distinct. Disc of elytron variegated yellow and brown-black. Ventral surface dark-brown, appendages a little lighter, apex of labial palpi dark-brown. Head sparsely covered with strong punctures, about 1.5 x size of eye facet, those towards front much smaller. Pronotum moderately but unevenly covered with strong punctures, a little larger than those on head, punctures tending to be

elongate longitudinally, a few isolated smaller punctures along front and rear margins, elytral striae moderately to strongly impressed. Second stria on elytron with 11 to 16 punctures. Punctures in striae, between striae and on pronotum subequal in size. Interstrial punctures lateral to stria 9 approximately arranged in one line. Ventral surface rugose-punctate. Midline of mesosternum weakly raised, moderately projecting backwards. Midline of first abdominal segment weakly carinate in front 1/4. Metacoxal process raised, triangularly produced backwards with a short narrow keel in midline at extreme rear and small narrowly oval area in middle devoid of sculpture. Rugose portion of metafemur 2/3 × length of femur, that of mesofemur 1/2–2/3 that of profemur 1/4–1/2 length of femur.

Male: Protarsi four-segmented, basal two segments broadly expanded, basal longer than second which is a little longer than the small third segment. Apical abdominal segment entire.

Remarks
A rare species from coastal N.T., readily recognised by the black head and predominantly black pronotum. The size and black head resemble the *B. approximans* group of species but the unlobed metacoxal process and lack of mesosternal pillar separate it from that group.

Distribution (Fig 82)
Coastal N.T.

Types
Holotype, male. '12°52'S, 132°50'E Koongarra, 15 km E of Mt. Cahill, N.T. 15.xi.1972, M. S. Upton', in ANIC. Paratypes; two, '16°28'S, 136°09'E 46 km SSW of Borroloola, N.T. 28 Oct, 1975. M. S. Upton', in ANIC; six, 'King River N.T. W. McLennan Pres. H. L. White 17.10.16', in NMV.

Berosus josephenae sp. nov.
(Figs 55, 61)

Description (number examined 19)
Length 5.5–6.0 mm. Elongate oval. Elytra not humpbacked. Apex of elytron weakly to quite strongly produced backwards, ending in two spines, the outer well-developed, the inner much less so. Dorsal surface light-brown, with patches on head, centre of pronotum, elytron, inner striae and punctures on elytron darker. Ventral surface dark brown-black, appendages lighter, rugose portions of meso and metafemora and tip of lapial palpi dark brown-black. Head strongly punctate, punctures larger than eye facets, punctures weakening towards front. Pronotum strongly densely and evenly punctate, punctures of one size except for a few smaller ones on extreme front and rear edges. Elytral striae strongly impressed. Stria 2 with 15 to 23 punctures about size of those on pronotum and 1.5 to 3 × size of those in adjacent interstrial area. Interstrial punctures relatively large, uniform in size, well impressed, arranged in more than one row over most of elytron, larger but shallower towards sides. Ventral surface strongly rugose-punctate. Midline of mesosternum weakly to moderately carinate, moderately projected backwards. Midline of first abdominal segment raised in front third. Metacoxal process raised, triangularly produced backwards, weakly ridged in midline except for a broadly diamond-shaped area in centre which is devoid of sculpture. Rugose portion of metafemur 2/3–3/4 length of femur, that of mesofemur 1/2–2/3, that of profemur about 1/2 length of femur.

Male: Protarsi four-segmented, basal segments moderately expanded, basal segment much longer than second segment which is about same length as much narrower third segment. Apical abdominal segment entire.

Remarks
As yet known only by a few specimens from coastal N.T., this rather elongate species is distinguished by its strong even punctation on the pronotum and the black rugose portions of the femora.

Distribution (Fig. 76)
Coastal N.T. and Cape York, Qld.

Types
Holotype, male, '12°23'S 132°57'E 5 km NNW of Cahills Crossing, N.T. East Alligator River, vi. 73, Upton & Foehan', in ANIC. Paratypes; six, two same data as holotype, in ANIC; one, 'Mareeba 22.v.1976 K. & E. Carnaby' in CW.; one, 'N.T. Junction of Arnhem Hwy & Oenpelli Road M.V. light 26–27 June 1980 M. B. Malipatil', in NTM; one, 'N.T. Lake Bennett area c. 25 km SE of Manton Dam 29–30 Dec. 1979. M. B. Malipatil', in NTM.

Berosus gibbae sp. nov.
(Figs 33, 39)

Description (number examined 17)
Length 4.0–5.0 mm. Elongate oval. Elytra not humpbacked. Shiny but with elytron of many specimens with a fine-meshed reticulation. Apex of elytron with a stout moderately-sized outer spine and a virtually absent inner one. Dorsal surface light-brown, elytral punctures and many striae and vague patches on head, pronotum and elytron darker. Ventral surface dark-brown, appendages lighter, except tip of labial palpi which is dark-brown. Head moderately densely covered with

strong punctures, strong, 2 × size of eye facets except towards front where they become much smaller. Pronotum evenly and quite densely covered with strong punctures, the same size as those at rear of head, a few smaller ones along front and rear margins. Elytral striae moderately impressed, with punctures the same size or slightly smaller than those on pronotum. Second elytron stria with 12 to 18 punctures. Punctures in interstriae smaller than those in striae, larger but shallowly impressed towards side, over most of elytron arranged in one or two irregular lines, often bearing a single seta particularly those towards sides. Punctures in interstria 3 of uniform size. Ventral surface densely but finely rugose-punctate. Midline of mesosternum strongly raised, moderately projecting backwards. Midline of first abdominal segment weakly carinate in front 1/2–1/4. Metacoxal process raised, triangularly produced backwards, with a broad diamond-shaped area in middle devoid of sculpture. Rugose portion of metafemur 2/3–3/4 length of femur, that of mesofemur 2/3, that of profemur about 1/2 length of femur on rear face.

Male: Protarsi four-segmented, basal segments weakly expanded. Basal segment longer than second, second and third segments subequal in all dimensions. Apical abdominal segment broadly but shallowly notched.

Remarks
This widespread northern species is rare in collections. The peculiar fine sculpture of the elytra, which is either irregular or with a fine grained reticulation, and the presence of a large number of setae- bearing punctures, are reminiscent of *B. nutans* and *B. dallasae* which show these characters to a greater extent. The more normal pattern of elytral punctation readily separates it from these species, in which the elytra are densely and evenly covered with punctures. The round rather than elongate pronotal punctures also separate it from these otherwise quite similar species. The light-coloured rugose portions of the femora separate it from *B. josephenae*.

Distribution (Fig. 78)
Coastal northern Australia.

Types
Holotype, male, 'N.T. Katherine low level Native Park, 25 Ap. 1980 M. B. Malipatil', in NTM. Paratypes; six, two same data as holotype in NTM; four 'N.T. N. P. Korlonjotlok Stream 18 Nov. 1979 M. B. Malipatil', in NTM.

Berosus majusculus Blackburn
(Figs 54, 60)

Berosus majusculus Blackburn, 1888 (1889), p. 824.

Types
Holotype and paratype in BM(NH), seen. Paratype, male, Adelaide, S.A. in SAM, seen.

Description (number examined 336)
Length 6.0–8.7 mm. Elongate oval, elytra not humpbacked. Apex of elytron with two well-developed spines, the outer longer than the inner. Dorsal surface brown with darker mottlings. Elytral punctures and striae black, strongly so on disc, weaker or absent on sides. Ventral surface black. Appendages brown, tip of labial palpi darker. Head relatively narrow, evenly strongly and quite closely punctate, punctures much weaker towards front. Pronotum unevenly covered with moderately dense, well-marked punctures, variable in size, a little stronger laterally with a row of small punctures along front and rear margins. Elytral striae well-impressed, second stria 1/4 length of elytra. Punctures in striae well-marked, same size or larger than those on pronotum, interstrial punctures not in one line except in some lateral interstriae; well-marked, a little smaller than those in striae, particularly on humeral angles. Reticulation of elytron absent to moderately strong. Ventral surface densely and evenly rugose-punctate. Midline of mesosternum tending to form weak keel, weakly projecting backwards. Midline of first abdominal segment with weak keel in anterior 1/4. Metacoxal process raised, narrowly triangular. Midline with long narrow area devoid of sculpture. Rugose portion of metafemur 1/2 to 2/3 length of femur, that on mesofemur a little over 1/3 along ventral face, that on profemur about 1/3 length of femur along ventral face.

Male: Protarsi four-segmented, basal two segments dilated. Basal segment about twice length of subequal second and third segments. Apical abdominal segment notched.

Remarks
This common southern species is readily separated from the rather similar *B. australiae* by lack of black rugose, femore. It is more difficult to separate from *B. veronicae*, with which it is generally sympatric, but it is larger and has a greater number of punctures on stria 2. The notch on the last abdominal segment of the male also separates this species from others of its size.

Distribution (Fig. 75)
Southern coastal Australia from Perth to Sydney areas.

Berosus veronicae sp. nov.
(Figs 67, 68)

Description (number examined 209)

Length 3.5–6.4 mm. Elongate oval, elytra not humpbacked. Apex of elytron with two weak blunt spines. Dorsal surface light-brown with darker mottlings. Elytral punctures and striae black, strongly so on disc in many specimens, weakly or not at all laterally. Ventral surface black, appendages light-brown, tip of labial palpi a little darker. Head evenly, strongly and quite closely punctate. Punctures toward front weaker. Pronotum evenly, strongly and quite closely punctate, scattered smaller punctures particularly on disc and front and rear margins, weakly reticulate in some. Elytron variably reticulate from none to moderate. Elytral striae well impressed. Second stria about 1/4 length of elytra. Strial punctures about size of larger punctures on pronotum. Interstriae 1 to 5 scattered, those between more lateral striae tending to be in one row except for extreme lateral edge. Ventral surface densely rugose-punctate. Midline of prosternum weakly and evenly keeled, projecting backwards in weak prosternal process. Midline of first abdominal segment weakly keeled in anterior 1/4. Metacoxal process raised, triangular, midline with diamond-shaped area devoid of sculpture in middle and slight keel to the rear of this area. Rugose portion of metafemur between 1/3 and 1/2 length of femur, that on mesofemur 1/3, that on profemur 1/4 length of femur.

Male: Protarsi four-segmented, basal two segments moderately expanded. First segment about twice length (and size) of second, which is a little longer than the narrow third segment. Apical abdominal segment entire.

Remarks

A common species in southern Australia, this species has frequently been mis-identified in collections, usually as *B. majusculus*. The unnotched apical segment in the male separates it from this species. The smaller size and fewer punctures in the area between the first two elytral striae will separate all but the occasional specimens. *B.albipes* Fauvel is another name that has been attached to specimens of this species but this is a species from New Caledonia with different aedeagus and other characters.

Distribution (Fig. 81)

South-eastern Australia, Tas.

Types

Holotype, male, 'Goulburn', in SAM. Paratypes, 13 same data as the holotype, in SAM; two, 'Albury N.S.W. 1/61 CW', in CW.

Berosus australiae Mulsant
(Figs 71, 74)

Berosus australiae Mulsant, 1859, p. 58.

Berosus externespinosus Fairmaire, 1879, p. 81, syn. after D'Orchymont, 1943.

Berosus gravis Blackburn, 1888 (89), p. 826, syn. nov.

Types

Berosus australiae, not located (Hope, Dept of Ent. Oxford, records it as having been sent to BM(NH) in 1925). Type locality 'Australia'.

Berosus gravis: Holotype, male, S.A., in BM(NH), seen. Paratype, male, in SAM, seen. Paratype, male, in SAM, seen. Type locality (Paratype), Murray Bridge, S.A.

Berosus externespinosus, not located (?MHNH). Type locality, Rockhampton, Qld.

Description (number examined 455)

Length 6.5–9.0 mm. Elongate oval, not humpbacked. Apex of elytron with two spines, the outer strong and usually about two times length of inner. Dorsal surface brown to dark-brown with darker motlings. Elytral striae and punctures outlined in black except for punctures laterally. Ventral surface black. Appendages brown, rugose portion of femora black or dark- brown. Punctures on head moderately strong and dense, much weaker towards front. Pronotum moderately covered with well-marked variable sized punctures, front and rear edges with rows of closely spaced small punctures. Elytron with striae moderately impressed, strial punctures relatively small, about same size as those on pronotum. Interstrial punctures scattered, smaller, those in more lateral interstriae tending to form a single line to varying degrees. Elytron surface shiny or weakly to moderately reticulate with a fine reticulation. Ventral surface densely rugose-punctate. Midline of mesosternum raised into weak keel, weakly projecting backwards. Midline of first abdominal segment weakly keeled in front 1/4. Metacoxal process raised, triangular, with diamond shaped area devoid of sculpture in midline. Rugose portion of metafemur 2/3–3/4 length of femur, that on mesofemur a little more than 1/2, that on profemur about 1/3 length of femur.

Male: Protarsi four-segmented, basal two segments strongly expanded, basal segment about 1.5 × length of second, which is much longer than the small third segment. Apical abdominal segment entire.

Remarks

In southern and eastern Australia this large common species is readily recognized by the black rugose portions of the femora. In northern Australia some specimens have the rugose portions dark-brown and not greatly darker than the rest of the leg, and closely resemble *B. sadieae* and *B. decipiens*. Separation of these three species is best

done on aedeagi as, although *B. australiae* is generally larger, and generally has stronger elytral punctures, this is not always so.

Distribution (Fig. 77)
Virtually Australia-wide, more common in south-east than elsewhere, rare in W.A., apparently absent from centre and north of that state.

Berosus decipiens Blackburn
(Figs 47, 52)

Berosus decipiens Blackburn, 1888, p. 827.

Types
Holotype and paratype in BM(NH), seen. Paratype in SAM, seen.

Description (number examined 18)
Length 6.1–8.0 mm. Elongate oval, not humpbacked. Apex of elytron with two weak spines placed close together. Reddish-brown with elytral striae and punctures on elytron and pronotum black, particularly on discs, black areas on elytron coalesced in some specimens to give extensive black areas on disc. Ventral surface black, appendages reddish-brown, rugose portions of femora darker. Head moderately punctate with rather shallow punctures, those in front half smaller. Pronotum sparsely and rather unevenly punctate with small to moderately-sized rather shallow punctures. Front and rear boarders with row of shallow small punctures. Elytral striae weakly impressed especially on disc where for most part reduced to a line of punctures. Strial punctures about same size as the large punctures on pronotum. Interstrial punctures sparse and shallow, those on disc smaller (usually much smaller) than those in adjacent striae, weaker laterally, strong tendency for interstrial punctures to be arranged in one line over most of elytron, in interstriae 3 and 5 there are some scattered larger punctures. Ventral surface rugose-punctate. Midline of mesosternum quite strongly and sharply carinate, weakly projecting backwards. Midline of first abdominal segment without keel. Metacoxal process raised, triangular with rather bowed sides. Midline weakly carinate behind, with narrow area in middle unsculptured. Rugose portion of metafemur 1/2–2/3 length of femur, that of mesofemur about 1/2, that of profemur a little over 1/2 length of femur.

Male: Protarsi four-segmented, basal two segments moderately expanded. First segment about 1.5 × length of second segment which is a little shorter than the narrow third segment.

Remarks
B. decipiens is a northern coastal species resembling *B. australiae*. It differs from that species by generally being a little smaller and more elongate, and by the weaker and less numerous punctures on elytra and pronotum. The aedeagus and the much larger third segment of the male protarsi separate it from *B. australiae*. I have found no characters that separate this species from *B. sadieae* other than the aedeagus.

Distribution (Fig. 78)
Coastal northern Australia from Wyndham, W.A., to Kuranda, Qld.

Berosus sadieae sp. nov.
(Figs 46, 50)

Description (number examined 2)
Length 4.5–5.0 mm. Narrowly oval. Shiny. Elytron not humpbacked. Apex of elytron with two weak spines, the inner one smaller than the outer. Dorsal surface light-brown, punctures on elytron and pronotum, elytral striae and patches on pronotum and elytron darker. Rear of head dark, centre and front lighter. Ventral surface dark-brown, appendages lighter, rugose portions of meso and metafemora somewhat darker than rest of legs. Tip of labial palpi dark. Head relatively narrow, relatively sparsely covered with well impressed punctures, about size of eye facet, smaller towards front. Pronotum sparsely covered with punctures, most about 1.5 × puncture width apart, towards midline and in front punctures vary in size. Elytral striae weakly to moderately impressed, strial punctures about size of the larger ones on pronotum. Interstrial punctures smaller. In interstriae 3 and 5 there are some scattered larger punctures. Punctures lateral to about stria 7 weak and arranged in one row, those inward of about stria 7 stronger and tend to be scattered. Stria 2 with 11 to 15 punctures which are about twice as large as those in adjacent interstrial areas. Ventral surface densely punctate. Midline of mesosternum raised, moderately projected backwards. Midline of first abdominal segment weakly raised in front 1/3. Metacoxal process raised, broadly triangularly produced backwards, with small wide diamond-shaped portion in middle devoid of sculpture. Rugose portion of metafemur 2/3 length of femur, that of mesofemur 1/2–2/3, that of profemur 1/2 length of femur.

Male: Protarsi four-segmented, basal segment weakly expanded, first segment larger than second which is same length but a little wider than third. Last abdominal segment entire.

Remarks
A northern species known for certain only from the two male types. These are indistinguishable from *B. decipiens* except for the distinctive aedeagus. Both species have been taken together at Howard Springs, N.T., and Lake Bennet, N.T. Further work

is needed to clarify the relationship of this northern group which also includes *B. australiae* and *B. aquilo*. A series of specimens from Lake Bennet, N.T., Dec. 1979, in NTM, includes both *B. sadieae* and *B. decipiens* but most are teneral which precludes extraction of an identifiable aedeagus, hence I cannot be sure to which species various individuals belong.

Distribution (Fig. 79)
Known only from the type localities.

Types
Holotype, male, 'Howard Springs, N.T., at light, 27.i.68, E. Matthews', in ANIC. Paratype, male, 'N.T., Lake Bennett area c. 25 km SE of Manton Dam, 29–30 Dec. 1979, M. B. Malipatil at M.V. light', in NTM.

Berosus aquilo sp. nov.
(Figs 34, 40)

Description (number examined 11)
Length 3.3–5.0 mm. Elongate oval. Elytra not humpbacked. Shiny. Apex of elytron with two spines, outer weakly to moderately developed, inner one often lacking. Dorsal surface light-brown, punctures and striae on elytron darker, elytron with one or two darker patches, rear of head darker. Ventral surface dark-brown and black. Appendages lighter, rugose portions of femora dark-brown to black. Head moderately covered with strong punctures about the same size as facets of the eye or slightly larger, much smaller towards front. Pronotal punctures same size as those at rear of head, rather unevenly distributed, all approximately the same size except for a few smaller ones along extreme front margin and on disc. Elytral striae moderately impressed, stronger towards sides and apex. Interstrial punctures smaller than those in striae, arranged in one line over most of elytron, except between striae 1 to 3 and 4 to 5. Area between striae 2 and 3 with a few larger punctures. Second elytral stria with 10 to 16 punctures which are about 3 × size of those in adjacent interstrial areas. Ventral surface densely rugose-punctate. Midline of mesosternum raised, moderately produced backwards. Midline of first abdominal segment carinate in front third. Metacoxal process raised, broadly triangularly produced backwards, midline weakly carinate, a small diamond-shaped area in centre devoid of sculpture. Rugose portion of metafemur 3/4 length of femur, that of mesofemur, 2/3, that of profemur 1/2–2/3 length of femur.

Male: Protarsi four-segmented, basal two segments strongly expanded, basal segment larger than second which is about same length as the unexpanded third.

Remarks
A small dark species from coastal N.T. The only small species in this grouping with the rugose portions of the femora darker than the rest of the femur, and usually almost black.

Distribution (Fig. 79)
Known only from the type locality and from Daly River Mission, N.T. (ANIC).

Types
Holotype, male, 'Coastal Plains Research Station, C.S.I.R.O. Darwin, N.T. at light, 30.v.66 E.C.B. Langfield', in ANIC. Paratypes, nine same data as holotype, seven in ANIC, two in CW.

Berosus vijae sp. nov.
(Figs 35, 41)

Description (number examined 31)
Length 3.0–4.5 mm. Narrowly oval, not humpbacked, apex of elytron with two weak broad spines. Yellow-brown, rear of head, areas adjacent to eyes, elytral striae, 2–3 vague patches behind middle of elytron, ventral surface except for appendages darker. Shiny. Head sparsely punctured with variably sized punctures, sparser and weaker towards front and centre. Pronotum sparsely punctured with variably sized but quite well impressed punctures, stronger and denser laterally, front and rear margins with a single row of small punctures irregularly spaced. Elytral striae moderately to quite strongly impressed, particularly towards apex of elytron. Punctures in striae well marked, about same size as the larger ones on pronotum. Interstrial punctures a little to much smaller than those in striae, arranged in single row except in interstrial 2 to 3 which has scattered large and small punctures. Second stria about 1/4 length of elytron with 9 to 13 punctures. Mesosternal keel weakly raised. Metacoxal process triangular with apex towards rear, a small approximately oval area in midline devoid of sculpture. Ventral surface, rugose-punctate with smallish punctures. First abdominal segment with weak midline keel in front 1/4. Rugose portion of metafemur 3/4 length of femur, that of mesofemur 2/3–3/4 that of profemur about 1/2 on front edge and a little greater on hind edge.
Male: Protarsi four-segmented. First three segments subequal in length, first moderately expanded, second rather less so and third not at all. Apical abdominal segment very weakly notched with weak protruberence at each side of notch.

Remarks
A small widespread northern species closely resembling *B. ralphi* and *B. veronicae*, separated by range of characters given in Table 2. Generally with

larger elytral punctures and more strongly impressed striae although these are weakly impressed on the disc in some specimens.

Distribution (Fig. 75)
Northern Australia, predominantly the western half.

Types
Holotype, male, 'Tindal, N.T. 14°31'S, 132°22'E. 1–20 Dec. 1967, light trap. W. J. M. Vestjens', in ANIC. Paratypes, four same data as holotype, in ANIC.

Berosus ralphi sp. nov.
(Figs 72, 73)

Description (number examined 18)
Length 3.5–4.5 mm. Oval. Not humpbacked. Apex of elytron truncate or very weakly produced into two broad short spines. Yellow-brown, punctures on elytron and a few small spots in apical 1/2 of elytron darker. Ventral abdominal segments other than apical are blotched darker. Shiny. Elytron often moderately reticulate. Punctures of head moderately impressed, sparse, smaller towards front and center. Punctures of pronotum moderately impressed, sparse, variable in size, with row of small punctures along extreme front and rear margins. Elytron striae moderately to weakly impressed. Punctures on striae close, well impressed, about size of larger pronotal punctures. Interstrial punctures much smaller than those in striae and scattered in interstriae one to five, strong tendency to be arranged in a single row in interstriae lateral to stria 6. Interstria 3 with punctures of two sizes. Stria 2 short, often poorly marked with 7 to 13 punctures. Mesosternal keel moderately raised. Metacoxal process, sharply triangularly produced backwards and downwards, a small slightly raised area in midline in centre. Ventral surface rugose-punctate. First abdominal segment with raised midline keel in front 1/4. Rugose portion of metafemur 3/4 length of femur, that on mesofemur 1/2–2/3, that on profemur 1/4–1/2 length of femur.

Male: Apical abdominal segment sinuate on hind margin. First two segments of protarsi expanded, third segment not expanded. First three segments progressively smaller in length.

Remarks
Similar in general facies to *B. vijae* and *B. veronicae* but differing from them in the greater number and smaller size of the punctures in the first elytral interstriae, where they are arranged in more than one line, and in characters of the aedeagus. In all specimens so far examined the tip of the metacoxal process is sharply deflexed downwards, a character not seen in other Australian *Berosus*.

Distribution (Fig. 77)
Coastal north-western Australia and 'Queensland.

Types
Holotype, male, 'Wyndham W.A. S. Stephens 20.2.01', in SAM. Paratyes 17; seven same data as holotype, in S.A.M, one 'Derby N.W.A. W. D. Dodd', in SAM; seven 'Derby N.W.A.', in SAM; two 'Queensland J.8261', in SAM.

Berosus subovatus Knisch
(Figs 36, 42)

Berosus sticticus Fairmaire, 1879, p. 82.
Berosus subovatus Knisch, 1924 (not Boheman, 1859).

Type
Holotype, female, Peak Downs N.T., in MNHN, seen.

Description (number examined four)
Length 4.6–5.0 mm. Elongate oval. Elytra not humpbacked. Shiny. Apex of elytron rounded or weakly truncated. Dorsal surface light-brown, punctures and striae on disc of elytron and vague patches on head, pronotum and elytron darker. Punctures in lateral striae on elytron with large squarish darkish subsurface markings. Ventral surface dark-brown to black, appendages lighter, rugose portions of femura with a slightly darker hue than rest of leg. Head with scattered relatively small punctures, those at back of head a little larger than size of eye facet, those towards centre and front of head smaller. Pronotum sparsely and unevenly covered with punctures, of two sizes, larger about same size as those at rear of head. Elytral striae weakly impressed, over most of elytron little more than series of punctures. Second elytral stria with 6 to 7 punctures, about same size or a little smaller than the larger ones on pronotum 2 × size of those in adjacent interstrial areas. Punctures in interstriae 3 and 5 of two sizes. Interstrial punctures lateral to stria 6 arranged in one line. Those towards sides and apex small and weakly impressed. Ventral surface finely rugose punctate. Midline of mesosternum moderately and evenly raised, moderately projected backwards. Midline of first abdominal segment weakly carinate in front 1/4. Metacoxal process raised, triangularly produced backwards, midline carinate in rear 1/4 a large roughly diamond-shaped area in middle, devoid of sculpture. Rugose portion of metafemur 2/3 length of femur, that of metafemur 2/3, that of profemur about 1/2 length of femur.

Male: Protarsi four-segmented, basal two segments moderately expanded. Basal segment larger than second which is larger than third.

Remarks
The relatively small number of punctures in the second elytral stria, strong tendency for punctures in interstriae to be arranged in one line, and sparse and variably-sized pronotal and head punctures separate this species from related species. *B. vijae* and *B. ralphi* are difficult to definitely separate from this species apart from the form of the aedeagus which is considerably shorter than the parameres in *B. subovatus*.

Distribution (Fig. 81)
Known from only two localities; Station Creek in north Qld. (in ANIC), and Katherine, N.T. (in ANIC). (The type is labelled 'Austral'.)

Berosus nicholasi sp. nov.
(Figs 66, 69)

Description (number examined 51)
Length 5.0–6.5 mm. Elongate oval. Elytra not humpbacked. Apex of elytron weakly extended with two small spines, inner one often small or lacking. Shiny, often moderately reticulate with a very fine even reticulation. Dorsal surface light-brown with punctures, elytral striae and patches on head, pronotum and elytron dark-brown. Ventral surface dark-brown to black with lighter mottlings. Appendages brown, tip of labial palpi darker. Head relatively narrow, evenly and quite densely covered with strong punctures, punctures weaker towards front. Pronotum moderately but unevenly covered with strongly impressed punctures of two general sizes with the larger ones predominating, rows of small punctures along front and rear margins. Elytral striae quite strongly impressed except towards sides and back. Strial punctures relatively small, a little smaller than the larger ones on the pronotum. Interstrial punctures small, relatively sparse, those lateral to stria 8 arranged in one line, smaller than strial punctures over most of elytron. Some of the more central interstriae with a few large punctures with short setae. Ventral surface densely rugose-punctate. Midline of mesosternum raised, moderately projecting backwards. Midline of first abdominal segment carinate only in extreme front. Metacoxal process raised, triangularly produced backwards, small elongate oval area in centre devoid of sculpture. Rugose portion of metafemur 2/3–1/4 length of metafemur, that of mesofemur 1/2–2/3, that of profemur 1/3–1/2 length of femur.

Male: Protarsi four-segmented. Basal segments subequal, quite strongly dilated. Apical abdominal segment not notched.

Remarks
One of a group of very similar northern species which can only be confidently separated by characters of the aedeagus. In all but a few cases, larger than other species in the group other than *B. debilipennis*, which usually has much stronger punctures on the elytron. See Table 2.

Distribution (Fig. 79)
Coastal northern Australia from Derby, W.A. to Townsville, Qld.

Types
Holotype, male '12°28'S 131°03'E Howard Springs, N.T. 24 km S of Darwin 10.xi.72. rainforest, at light, E. Britton', in ANIC. Paratypes, 12 same data as holotype; 11 in ANIC, one in CW.

Berosus debilipennis Blackburn
(Figs 44, 45, 49, 51)

Berosus debilipennis Blackburn, 1898, p. 223.

Type
Holotype, female, Cape York, Qld. in BM(NH), seen.

Description (number examined 74)
Length 4.0–6.0mm. Elongate oval. Elytra not humpbacked. Apex of elytron rounded or with two weak spines. Dorsal surface light-brown with punctures on pronotum and elytron, elytral striae and patches on pronotum and elytron darker. Rear of head dark-brown, centre and front lighter. Ventral surface dark-brown, appendages lighter, tip of labial palpi dark-brown. Head with sparse to moderately dense, strong punctures, a little larger than eye facets, grading to obsolete towards front. Pronotum rather unevenly but moderately covered with strong punctures the size of those at rear of head, a few smaller punctures towards midline and front. Elytral striae quite strongly impressed particularly laterally and towards rear. Second elytral striae with 10 to 18 punctures, 2 x the size of those in adjacent interstrial areas. Interstrial punctures scattered not arranged in a single row except in some places towards sides and rear. A few large punctures in interstriae 3 and 5. Ventral surface densely rugose-punctate. Midline of mesosternum weakly raised, moderately projected backwards. Midline of first abdominal segment weakly carinate at extreme front. Metacoxal process raised, narrowly triangularly produced backwards, with a narrow diamond-shaped area in middle unsculptured. Rugose portion of metafemur 2/3–3/4 length of femur, that of mesofemur 1/2–2/3, that of profemur 1/3–1/2 length of femur.

Male: Protarsi four-segmented. First and second segments moderately expanded, first much longer than second, which is about the same length as third. Apical abdominal segment broadly but very weakly notched.

Remarks
A widespread northern species which I initially considered to be composed of at least two species. Further study may show that it includes several closely related species. In particular, individuals can be placed in one of two groups according to the shape of the aedeagus. One group has the parameres thin and the aedeagus roundly hooded at the tip, the other has thick parameres and has a transverse ridge on the upper surface behind the roughened end portion of the aedeagus. These characters are to some extent variable and intermediates exist, e.g. notably a specimen from Cunnamulla, Qld., in SAM. This species can be separated from the rather similar *B. nicholasi* by the usually much stronger elytral punctures and the relatively smaller second segment of the male protarsi (Table 2).

Distribution (Fig. 80)
Coastal northern Australia from Derby to Cairns region.

Checklist of Australian *Berosus*
(in alphabetical order)

B. australiae Mulsant
  = *externespinosus* Fairmaire
  = *gravis* Blackburn
B. amoenus sp. nov.
B. arcus sp. nov.
B. approximans Fairmaire
  = *B. auriceps* Blackburn
  = *B. blackburni* Zaitz
  = *B. ovipennis* Fairmaire
  = *B. simulans* Blackburn
  = *B. stigmaticollis* Fairmaire
B. aquilo sp. nov.
B. dallasae sp. nov.
B. debilipennis Blackburn
B. decipiens Blackburn
B. discolor Blackburn
  = *B. flindersi* Blackburn
B. duplopunctatus Blackburn
B. gibbae sp. nov.
B. involutus (W. MacLeay)
B. josephenae sp. nov.
B. juxtadiscolor sp. nov.
B. macropunctatus sp. nov.
B. macumbensis Blackburn
B. majusculus Blackburn
B. munitipennis Blackburn
B. nicholasi sp. nov.
B. niger sp. nov.
B. nutans (W. MacLeay)
  = *B. pallidulus* Fairmaire
B. pulchellus W. MacLeay
  = *B. devisi* Blackburn
B. queenslandicus Blackburn
  = *B. quartinus* d'Orchymont
B. quadrapunctatus sp. nov.
B. ralphi sp. nov.
B. reardoni sp. nov.
B. sadieae sp. nov.
B. subovatus Knisch
  = *B. sticticus* Fairmaire
B. trishae sp. nov.
B. timmsi sp. nov.
B. veronicae sp. nov.
B. vijae sp. nov.

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The Curators of the collections listed earlier are thanked for the free and rapid access to their collections afforded to me. Dr E. Matthews kindly read portions of the manuscript and greatly improved it. Mrs P. Kidd's expert typing of the various drafts is greatly appreciated as is Miss J. Thurmer's drawings of elytrae and other structures. Mrs. Marianne Anthony, Librarian of the S.A. Museum, ferreted out obscure references without which progress would have been much slower.

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NABIDAE (HETEROPTERA) OF VANUATU

I. M. KERZHNER

KERZHNER, I. M. 1987. Nabidae (Heteroptera) of Vanuatu. *Rec. S. Aust. Mus.* 21(1): 29–33.

Six species are listed, one of them (*Stenonabis nitidicollis* Kerzh.) is new from the Vanuatu fauna. Keys to adult Nabidae and to fifth instar larvae of *Arbela* occurring in Vanuatu are given.

I. M. Kerzhner, Zoological Institute, Academy of Sciences of the U.S.S.R., Leningrad 199034, U.S.S.R. Manuscript received 17 February 1986.

Previous records of Nabidae from Vanuatu (formerly the New Hebrides) were based on the material in the Museum National d'Histoire Naturelle, Paris (Reuter 1908); the British Museum (Natural History), London (Harris 1938, 1939; Kerzhner 1970a); and the Universitetets Zoologiske Museum, Copenhagen (Kerzhner 1970b). In all, five species have been recorded.

The material received from the South Australian Museum, the B. P. Bishop Museum and the U.S. National Museum of Natural History (thanks to the kindness of Dr G. F. Gross, the late Dr J. L. Gressitt and Dr Th. J. Henry) contains all of the species already known from Vanuatu and one species new for the fauna.

In the distribution lists below, only localities and collecting dates are mentioned. The data on expeditions, collectors and deposition of material for corresponding years are as follows:

1943 — collector Knight; deposited in the U.S. National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA;

1950 and 1970 — collector N. L. H. Krauss; deposited in the B. P. Bishop Museum, Honolulu, Hawaii, USA;

1957 — collector J. L. Gressitt; the same museum;

1958 — collector Borys Malkin; the same museum;

1960 — collector W. W. Brandt; the same museum;

1964 — collector R. Straatman; the same museum;

1965 — Biospeleological Expedition, collector G. F. Gross; deposited in the South Australian Museum, Adelaide, South Australia;

1967 — collectors J. & M. Sedlaček; deposited in the B. P. Bishop Museum;

1971 — Royal Society and Percy Sladen Expedition; collectors — P. Cochereau (on Malekula I.), G. F. Gross (on all other islands), Masing Andrew (who assisted G. F. Gross on Tanna I.); deposited in the South Australian Museum, but duplicates from large series will be sent to British Museum (Natural History), Museum National d'Histoire Naturelle, Paris, or will be retained in Zoological Institute, Leningrad;

1973 and 1976 — collector N. L. H. Krauss; deposited in the U.S. National Museum of Natural History.

Systematics

Gorpis simillimus Harris
(Figs 1–3)

Previous records

MALEKULA. Harris 1939: 150–151.

Material examined

ESPIRITU SANTO: Apouna R. Camp 2, 146 m, 30.VIII.1971, at light, 1 ♀; above Namatasopa, 400 m, 30.VIII.1957, 1 ♀; Hill E. of Luganville, 100 m, Macaranga, 10.IX.1957, 1 ♂.

General distribution

Vanuatu (type locality) and Solomon Islands.

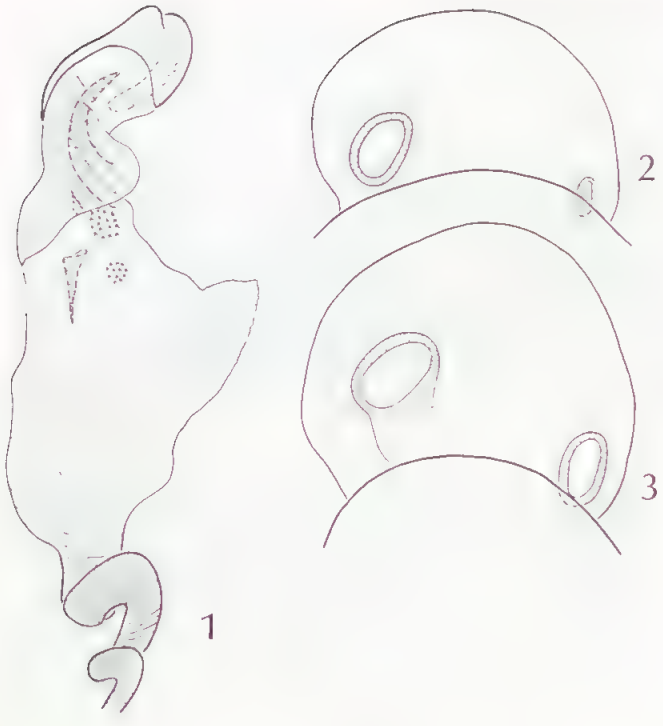
Remarks

Previously (Kerzhner 1970a) I mentioned that there were some colour differences between specimens from Vanuatu and the Solomon Islands. These differences are in the main confirmed by the new material. In addition, slight differences in male and female genitalia (Figs 1–3) have been found. However the material at hand is insufficient for a study of individual variability and therefore I refrain from description of a new subspecies for the Solomon Islands population.

Arbela immista Harris

Previous records

MALEKULA. Harris 1938: 579; Kerzhner 1970a: 298; 1970b: 192.



FIGURES 1-3. *Gorpis simillimus* Harris. 1, male from Vanuatu (Espiritu Santo), aedeagus; 2, female from Vanuatu (Espiritu Santo), vagina in ventral aspect; 3, female from Solomon Islands (Guadalcanal), the same.

Material examined

ESPIRITU SANTO: Baldwin Bay, 17.VIII. 1958, 1 ♀; 25 km NE Luganville, 12.IV.1964, 1 ♂, 1 ♀. PENTECOST (NE): 200-500 m, 27.III.1964, 1 ♂. MALEKULA: Amok, 17.IX.1958, 1 ♂; South West Bay, 11 and 13.X.1971, by beating trees and sweeping grasses in the forest and along the river of the forest, 9 ♂, 10 ♀, 4 larvae.

General distribution

Vanuatu (type locality) and the Bismarck Archipelago.

Arbela costalis Stål

Previous records

BANKS, MALEKULA, ERROMANGA. Harris 1938: 581; Kerzhner 1970a: 298.

Material examined

API ('Epi'): Vaemali, 10.VIII.1967, 1 ♂. ERROMANGA: Ipota, 0-100 m, March 1970, 2 ♂; Ipota, vicinity of Ipota, and River Camp between Ipota and Nuankao, 4, 5, 7, 12.VIII.1971, 4 ♂, 3 ♀. TANNA: Lenakel, 0-150 m, March 1970, 1 ♀; between Lenakel and Bethel, 28.VII.1971, 1 larva. ANEITYUM: vicinity of Analgahaut, 19.VII.1971, 1 ♂, 1 larva.

General distribution

Fiji (type locality), Samoa, Vanuatu and Solomon Islands.

Arbela nitidula (Stål)

Previous records

MALEKULA. Reuter 1908: 127; Harris 1938: 568.

Material examined

ESPIRITU SANTO: Segond Channel, Santo, Aug. 1950, 2 ♀; Namatasopa, 300 m, 28.VIII.1957, 1 ♀; below Namatasopa, 250 m, 2 and 3.IX.1957, 1 ♂, 1 ♀; Tasmalum, 3 m, bush, 4.IX.1957, 1 ♂; Luganville, 23-28.VII.1958, 1 ♂; Baldwin Bay, 28-30.IX.1958, 1 ♀; Narango, 90 m, May-June 1960, 2 ♀; Apouna R. Camp 2, 146.3 m, 2, 3.IX.1971, 10 ♂, 7 ♀, 3 larvae; Malao Village, Big Bay Area, 23.VIII.1971, 1 larva. MALEKULA: Amok, 17.IX.1958, 3 ♂, 4 ♀, 1 larva; South West Bay, 13-14.X.1971, beating small trees and sweeping grasses along the river to the forest and on swamp, 4 ♂, 2 ♀. EFATE: Maat (Mat, Ambryn Vill.), 3 m, 15.VIII.1957, 1 ♀; Limestone, Plateau N of Maat, 100 m, 18, 20.VIII.1957, 2 ♂; Vila, 0-100 m, Jan. 1976, 1 ♀. ERROMANGA: Ipota, 5.VIII.1971, 3 ♀. TANNA: between Lenakel and Balhel, 28.VII.1971, 1 ♂, 2 ♀. ANEITYUM: vicinity of Analgahaut, 18-20.VII.1971, 3 ♀.

General distribution

From India and south China to Vanuatu.

Stenonabis nitidicollis Kerzhner
(Figs 4-6)

Material examined

ESPIRITU SANTO: Nokowoula, 1100 m, 14.IX.1971, by sweeping, 1 brachypterous female.

General distribution

Australia, Vanuatu (new record).

Remarks

S. nitidicollis was described (Kerzhner 1970a) from a macropterous female, collected in New South Wales. Mrs N. Strommer (formerly N. Winkler), now in Heathmount, Melbourne, kindly informed me that she has examined macropterous and brachypterous males and females of *S. nitidicollis* from Queensland. I compared the

female (Fig. 4) from Vanuatu with the holotype of *S. nitidicollis*.

The vagina in the Vanuatu female (Figs 5, 6) is slightly larger (width 1.00 mm, in the holotype 0.93 mm), the dark coloration of the body is more pronounced and the hind lobe of pronotum has an intermediate longitudinal brownish stripe on each side between the medial and lateral stripes, the antennae are longer (length of the first segment 0.93 mm, of the second 1.33 mm), and also the legs and rostrum are slightly longer. All these differences do not surpass the level of individual and geographic variability in related species.

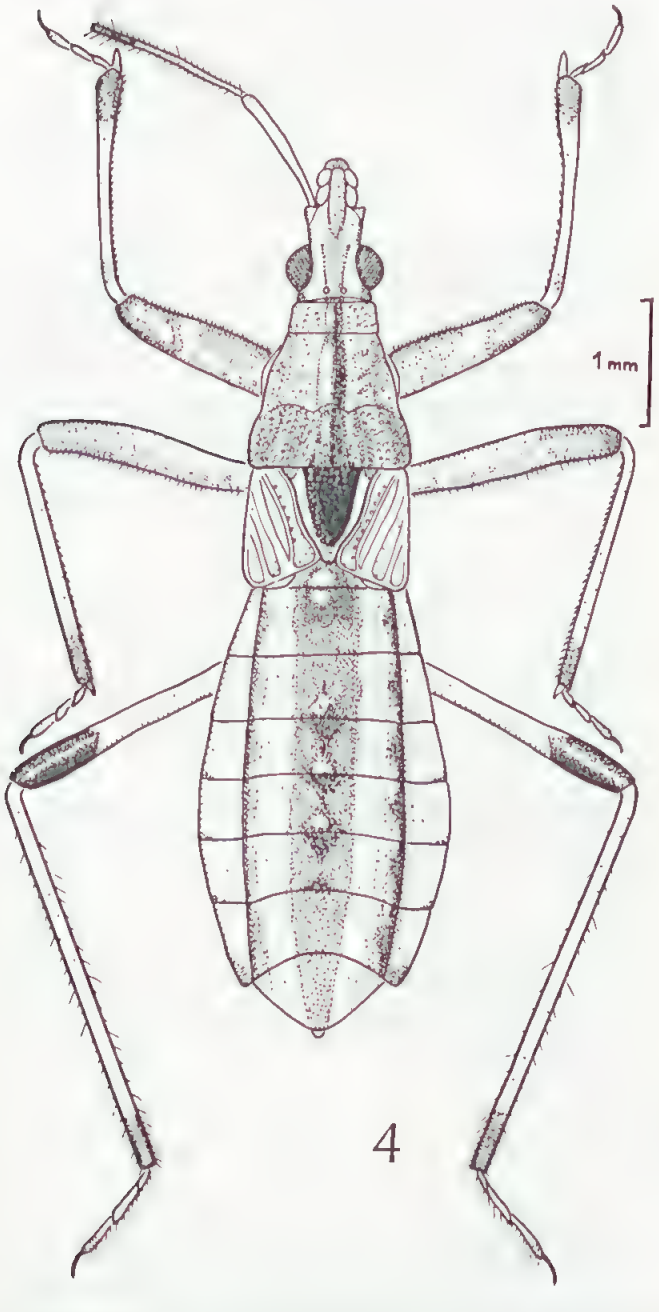
In the Vanuatu specimen, head width 0.76 mm, vertex width 0.34 mm, hind lobe of pronotum length 0.43 mm, width 1.29 mm, scutellum of equal length and width, body length 6.7 mm, width of abdomen 2.0 mm.

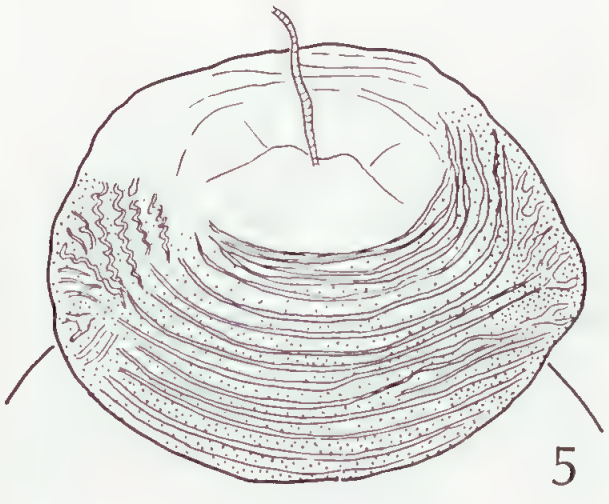
Nabis (Tropiconabis) kinbergii Reuter, 1872

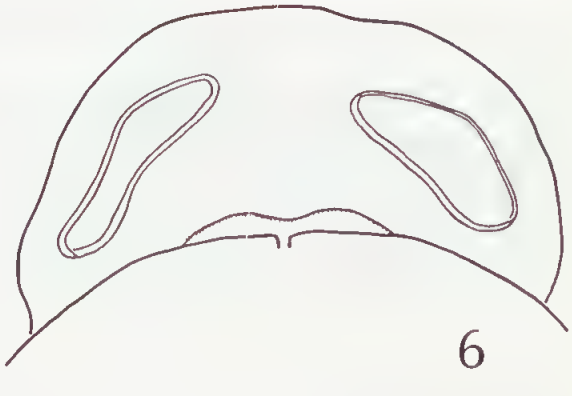
Nabis nigrolineatus (Distant, 1920). *Nabis tasmanicus* Remane, 1964. *Nabis capsiformis* auctt. (non Germar, 1838), part.

Previous records

'NEW HEBRIDES' (as *Reduviolus capsiformis*). Reuter 1908: 114. TANNA (as *Nabis nigrolineatus*). Kerzhner 1970a: 355.







FIGURES 4–6. *Stenonabis nitidicollis* Kerzhner, brachypterous female from Vanuatu. 4, dorsal aspect; 5, vagina in dorsal aspect; 6, vagina in ventral aspect.

Material examined

ESPIRITU SANTO: no exact locality, Oct. 1943, 1 ♀; Segond Channel, Santo, Aug. 1950, 1 ♀; Luganville, 20, 23–28.VII.1958, 17 ♂, 2 ♀, 1 larva; 10 km W. Luganville, 10.III.1964, 1 ♀; Santo, 13, 14.XII.1965, 1 ♂, 1 ♀; Malao Village in Big Bay Area, 28.VIII.1971, 1 ♀. MALEKULA: Amok, 17.IX.1958, 1 ♀, 1 larva; Lakatoro, 16–17.X.1971, 1 ♂. EFATE: Vila, Aug. 1950, 1 ♀; Vila, 0–100 m, Feb. and March 1970, 1 ♂, 1 ♀; Vila, 0–200 m, Feb. 1973, 1 ♀; Vila, 0–100 m, Jan. 1976, 2♂; SE corner, 10.VII.1971, 1 ♂, 1 ♀; Plantation Gaillarde nr. Tagobe, 11.VII.1971, 1 ♀. ERROMANGA: 11 km W. of Ipota, 100–200 m, Feb. 1970, 1 ♂; Ipota, 0–100 m, March 1970, 1 ♂; Ipota and vicinity of Ipota, 5, 6, 10, 12.VIII.1971, 5 ♂, 9 ♀. TANNA: East Coast, 450 m, 8.III.1964, 1 ♂, 1 ♀. Some specimens are taken at light.

General distribution

Australia and Pacific islands. The most remote records are Ryukyu and Bonin Islands, New Guinea, Samoa, Society Islands and New Zealand.

Remarks

The species was known formerly as *N. tasmanicus* and then as *N. nigrolineatus*. However some doubts existed on the last name because W. L. Distant described the species in Reduviidae (genus *Sastrapada*) and mentioned a number of characters not appropriate to Nabidae. I examined the type series of *N. kinbergii* (Naturhistoriska Riksmuseet, Stockholm), which included 1 female from Sydney, belonging to *N. nigrolineatus*, and 2 females from Buenos-Aires, belonging to *N. capsiformis*. I designated the specimen from Sydney as the lectotype of *N. kinbergii* and this name should be used for the species occurring in Australia and surrounding islands (Kerzhner 1981; Woodward & Strommer 1982).

Key to adult Nabidae occurring in Vanuatu

Note. The key is intended only for determination of Vanuatu material, therefore some of the characters mentioned are not applicable to all species of included genera nor to all populations of the included species.

1. Fore coxal cavities closed behind. Fore coxae slender, greatly elongated. Fore tibiae curved, shorter than fore femora ..... *Gorpis* Stål
   One species — *G. simillimus* Harris
— Fore coxal cavities open behind. Fore coxae nearly conical, less than twice as long as thick. Fore tibiae straight, subequal in length to the fore femora 2

2. Fore and middle femora and tibiae with long slender spines. Ocelli contiguous *Arbela* Stål (see 3)
— Femora and tibiae without long spines. Ocelli well separated 5

3. Pronotum dirty yellow with two longitudinal brown or black stripes, seldom completely light coloured. Hind lobe of pronotum not dull, but not so strongly shining as the fore lobe. Hind tibiae of the male with a densely pilose sub-basal thickening ..... *A. nitidula* (Stål)
— Pronotum (except in distinctly teneral specimens) completely black or with only corners or sides of the hind lobe yellow. Hind lobe of pronotum either velvety dull, or as strongly shining as the fore lobe. Hind tibiae of the male without thickening 4

4. Hind lobe of pronotum dull .... *A. immista* Harris
— Hind lobe of pronotum strongly shining .... *A. costalis* Stål

5. Hind lobe of pronotum punctured. Connexivum below not separated from the venter by a suture. Short- or long-winged ..... *Stenonabis* Reuter
   One species — *S. nitidicollis* Kerzhner
— Hind lobe of pronotum without punctures, Connexivum below separated from the venter by a suture lying in a deep impression. Long-winged ... . *Nabis* Latreille
   One species — *N. kinbergii* Reuter

Key to fifth instar larvae of *Arbela* occurring in Vanuatu

1. Wing pads black with the apical third white .... *A. immista* Harris
— Wing pads unicolorous 2

2. Wing pads black ..... *A costalis* Stål
— Wing pads light coloured ..... *A. nitidula* (Stål)

Acknowledgments

I am very thankful to Dr G. F. Gross, to the late Dr J. L. Gressitt and to Dr Th. J. Henry for the interesting material and to Dr N. Strommer for the information on *Stenonabis nitidicollis*.

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INTRODUCTORY STUDY OF ADVANCED ORIBATE MITES (ACARIDA: CRYPTOSTIGMATA: PLANOFISSURAE) AND A REDESCRIPTION OF THE ONLY VALID SPECIES OF *CONSTRICTOBATES* (ORIPODOIDEA)

D. C. LEE

LEE, D. C. 1987. Introductory study of advanced oribate mites (Acarida: Cryptostigmata: Planofissurae) and a redescription of the only valid species of *Constrictobates* (Oripodoidea). *Rec. S. Aust. Mus.* **21**(1): 35–42.

The study of advanced oribate mites (Planofissurae, new name) is introduced as a further part of an ongoing study of sarcoptiform mites from South Australian surface soils. Morphology is considered with reference to a unified notation for hysteronotal chaetotaxy, notal pores, the form of leg trochanters, acetabula and apodemes. *Constrictobates lineolatus* Balogh and Mahunka is redescribed from South Australian material, the generic diagnosis is modified, Constrictobatinae (Fenicheliidae) is newly synonymised with Pseudoppiinae (Oribatulidae), and the superfamily Oripodoidea is considered.

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This is a further part of an ongoing study of sarcoptiform mites from surface soil sampled from nine florally diverse South Australian sites. The primitive oribate mites have been considered elsewhere (Lee 1981, 1982, 1985), and here the study of advanced oribate mites is introduced. The majority of the oribate mites sampled belong to this group which, because of morphological changes, requires a consideration of homology and notation. Furthermore, because a new diagnostic character state for these mites is recognised, and the opinion that they should be unnamed (Lee 1985) is revoked, they are rediagnosed and dealt with under a new name (Planofissurae).

The description of the primitive oribate mites in this study has been thorough but time-consuming. Balogh & Mahunka (1983) suggest that 'painstaking scrutiny, using some recently discovered features' is not worth doing for only some members of a genus. Whilst appreciating this point, the paucity of a common denominator description is so limiting for many oribate mite groups that a more substantial level had to be undertaken, but not to such an extent as in my previous work. The dorsal and ventral aspects of the soma and the shape of the leg segments have been described, but not the gnathosternum or the chaetotaxy and form of the hairs on the legs.

The first superfamily to be considered is the Oripodoidea, partly because it is a diverse and dominant group within the well-established Poronotae, and partly because it is not only important in the study of soil zoology, but some of its members are intermediate hosts of anoplocephalid tapeworms, being infected by the cystercercoid (bladder worm) stage. The most recent work on the Oripodoidea is by Balogh & Balogh (1984), referring to it as the 'Oribatuloidea' as well as excluding the Mochlozetidae and Parakalummidae. It includes 20 families in the superfamily, of which half are listed as new. The work gives great importance to whether or not the hysteronotal foramina are multiporose, sacculate or a mixture of both those character states. The keys and diagnoses use few character states, which for Constrictobatinae (the only family group so far considered) are in part inaccurate. Despite this, the work is valuable on the basis for studying oripodoids.

Constrictobates was selected as an example, because it is unique within the Oribatuloidea in having 15 pairs of hysteronotal setae on the adult. This is only one pair less than in the holotrichous state amongst primitive oribate mites and is therefore valuable in homologizing the hysteronotal chaetotaxy of the two groups.

The South Australian mites examined are deposited in the South Australian Museum; the types have been returned to the Hungarian National Museum.

MORPHOLOGY

Hysteronotal chaetotaxy

There are three regularly used notational systems for the hysteronotal chaetotaxy, depending on whether they have a full complement of either 16, 15 or 10 pairs of setae. The multiplicity of systems is based on uncertainties of homology. I introduced another system (Lee 1981) for the primitive oribate mites (16-pairs chaetotaxy) with the intention of applying it to all sarcoptiform mites. The chaetotaxy

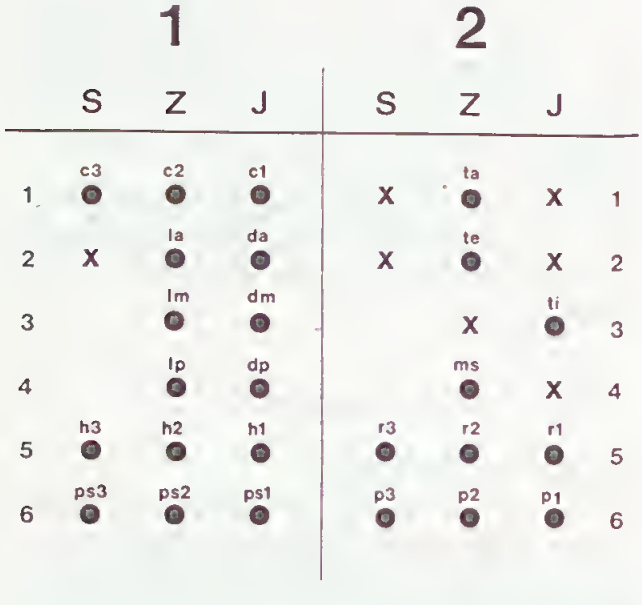
of oripodoid mites, for which both the 15-pairs and 10-pairs chaetotaxies have been used, is homologized here with the 16-pairs system as illustrated (Figs 1, 2). Because most advanced oribate mites have 15 pairs of hysteronotal setae on the tritonymph, both systems have sometimes been used for one species. Certainly, with the substantial change in form between the nymphal and adult stages, any proposals of homology are uncertain. On the other hand, I consider that the heuristic advantage of a uniform notation outweighs the disadvantage of using an uncertain homology.

Previously (Grandjean 1954, Lee 1984) it has been stated that all Planofissurae (=Circumdehiscentiae) lack seta *J*4 (=*f*1). The loss of *J*4 (and often *J*2 and *J*3) occurs in the most primitive subsection of the Planofissurae, the Pherenotae, with the exception of the Hermaniellidae where such setae are very small under the hysteronotal scalp, but there is a derived reversal of this loss and the seta that is absent from the 15-pair system of the oripodoid mites is *S*2.

The possible loss of setae in handling specimens, when only a few are available, can make it uncertain as to whether a setal base locates a vestigial or a broken off seta. In either case, it will be regarded as present in the chaetotaxy.

Notal pores

The slit-like pores (*hf*1–*hf*6) and the pore leading to the hysteronotal gland duct (*hGf*) are treated as before, but the notation and signatures for the areae porosae, sacculi and reduced sacculi are changed. There is little doubt that these three structures



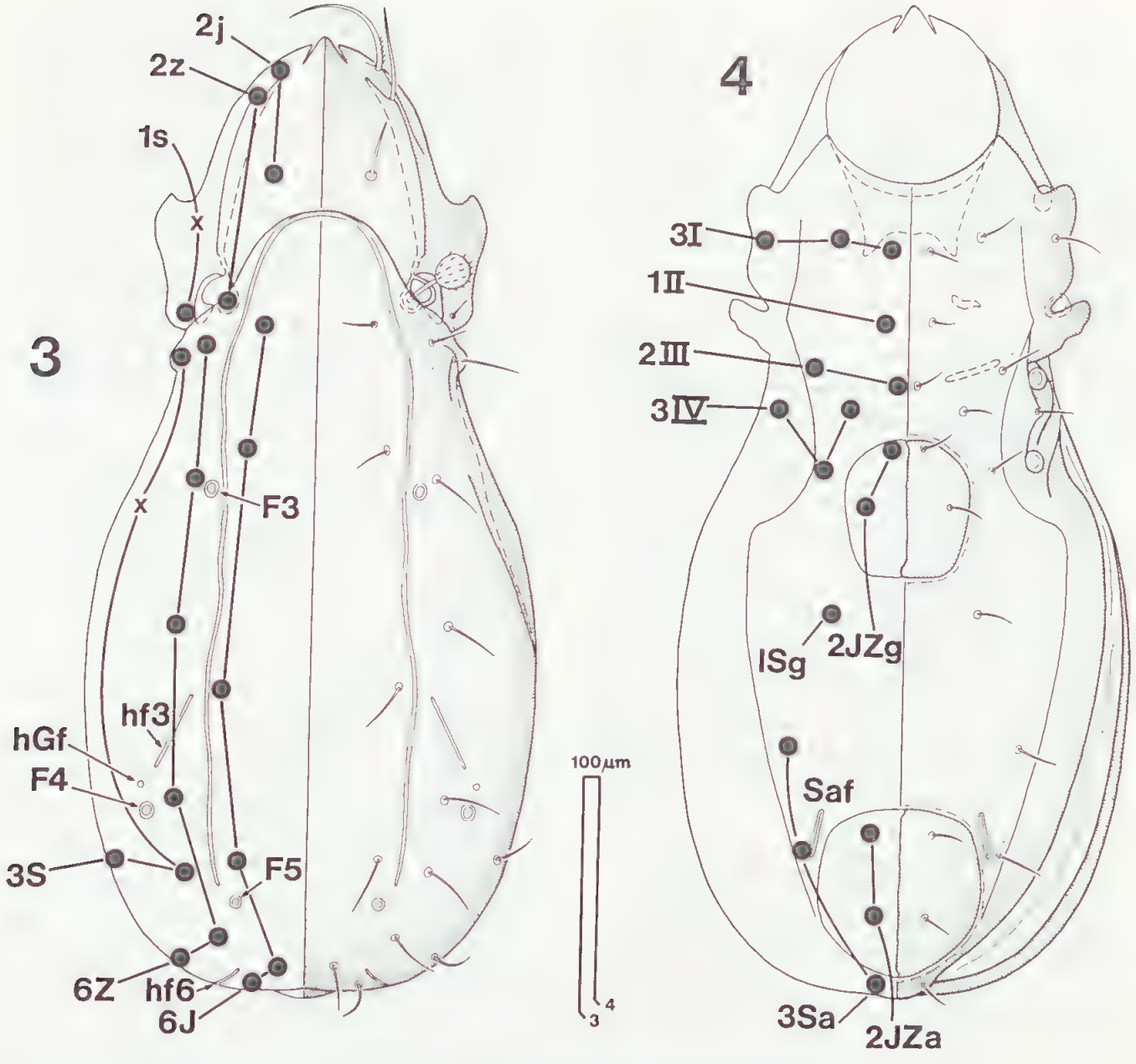
FIGURES 1 AND 2. Equivalent notations for hysteronotal chaetotaxy used in this study (signatures at periphery with capital letters for files and numbers for ranks). 1, 15-pairs system (*c*2 etc.); 2, 10-pairs system (*ta* etc.). x = seta absent, would be present in full complement of 16 setal pairs.

(sometimes referred to as octotaxic organs because four pairs are often conspicuous on the hysteronotum) are homologous, but their function is uncertain. They are often regarded as respiratory (Wallwork 1969), but they may be either respiratory or glandular (Hammen 1980). Here they are referred to as *foramina* (singular: *foramen*), and as either multiporose, sacculate, or uniporose. The term 'foramen' has been used for a thin patch bearing the infracapitular gland orifice on the gnathosternum (Hammen 1983), but this is considered as the unnecessary commitment of a valuable term to a trivial structure. The commonest state of the foramina is multiporose, which is regarded as primitive. The hysteronotal foramina may be sacculate or uniporose, which are regarded as derived. Their signature is '*F*' and the foramina are numbered depending on position: lateral proteronotal (*F*1), dorsosejugal (*F*2*d*), laterosejugal (*F*2*l*), the four hysteronotal pairs (*F*3, *F*4, *F*5, *F*6), a postanal strip (*F*7). A particular hysteronotal foramen may be divided into two parts, which are then given the signature suffix of either '*a*' or '*b*'.

Form of leg segments (particularly the trochanter) and the acetabular cavity

Mite leg segments are primitively *subcylindrical*, with some tapering, and with only moderate variation in segment size. This is the case in primitive oribate mite groups except that the coxa is merged into the podosoma. Diversification in shape and size has been derived in at least two suborders (Profissurida, Comalida). It is difficult to rigidly categorize the various shapes, but the derived segment shape is termed *pedunculate*. The pedunculate segment has a caput, stalk and pedestal. The proximal stalk varies in relative size, as to whether it is gradually or abruptly delineated from the caput and as to whether its axis is continuous with or at an angle to that of the caput. The pedestal may be an inconspicuous flared out base to the stalk or it may be larger than the stalk and caput combined (Fig. 6 — note trochantera I and II, state found in all Planofissurae).

The acetabulum is a socket in the coxite (merged coxa with podosoma). In most primitive oribate mites the socket edge is level with the rest of the prosomatic exoskeleton, but there may be a derived state where the raised edge partly encloses the trochanter (e.g. *Phyllhermannia eusetosa* Lee, 1985: Fig. 5). In contrast, the trochanteral pedestal of the Planofissurae is totally encompassed within an *acetabular cavity* (not illustrated since it is internal), which has a proximal *acetabulum* and an external aperture, termed the *acetabular access*. In the case of legs I and II, the trochanter is represented mainly by its pedestal, and is nearly absent externally. Apodemes extend from the proximal walls of



FIGURES 3 AND 4. *Constrictobates lineolatus*, female soma. 3, notum; 4, idiosternum.

acetabular cavities to bases on the prosternal integument. The full complement of *prosternal apodeme bases* is five pairs (I, II, sejugal, III, IV). There is also a pleural apodeme associated with the sejugal furrow, which merges dorsally with the bothridium to seta *zl*, termed the *bothridial apodeme*.

The trochanter is illustrated in this paper (Fig. 6) in order to demonstrate a synapomorphy of the Planofissurae, but when it is similar to this in later works it may not be figured. Although hairs of the legs are not normally considered, they may be illustrated in some cases in relation to segment shape as with the long, flagelliform solenidia on tubercles or a ventral setae near a flange a femur *II*.

Measurements

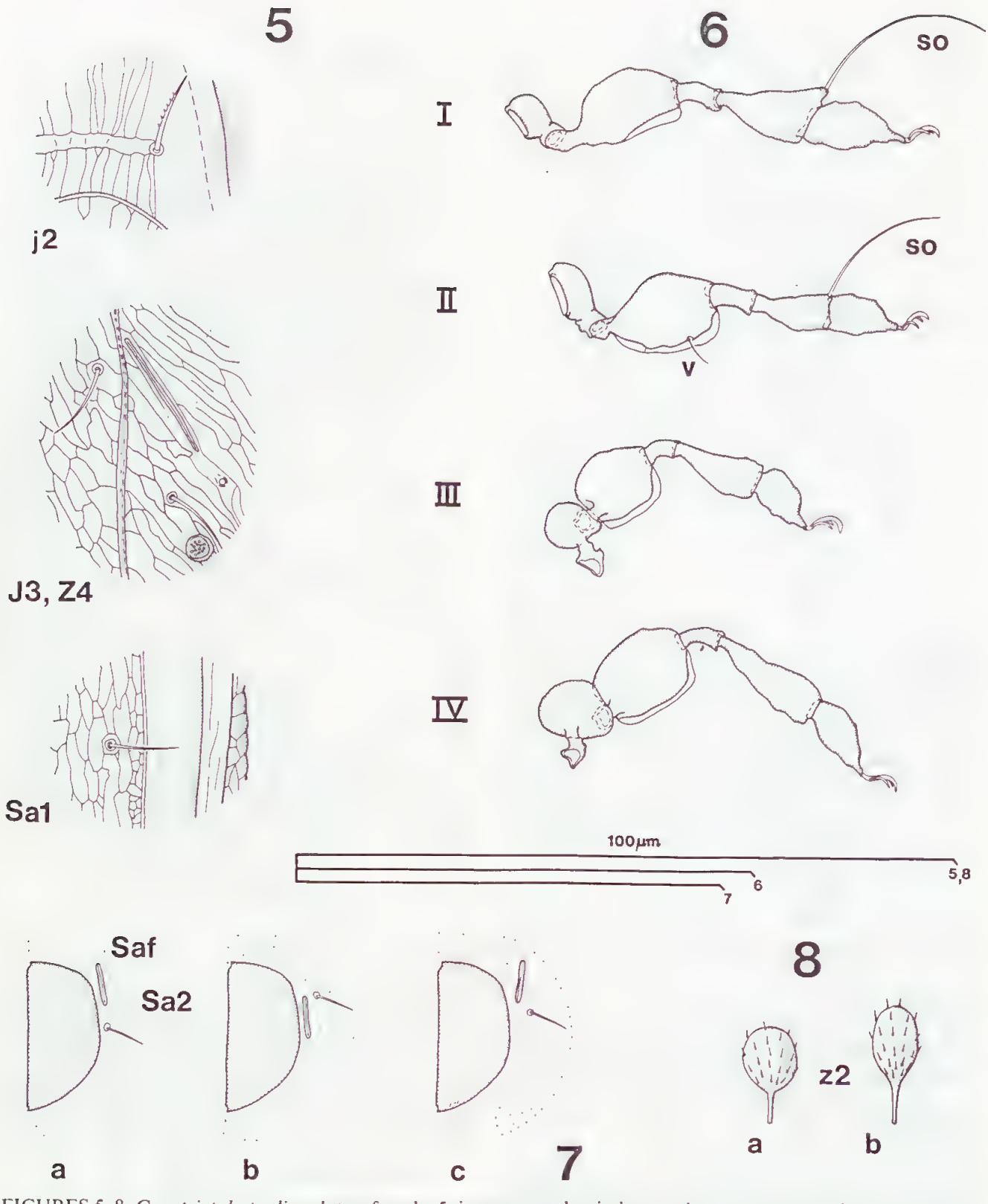
Measurements are in microns (μm) and applied as before (Lee 1981: 201), except that gnathosternal appendages are not considered. Also, because the trochantera are either obscured in the soma or have an angled stalk, they are excluded from the leg measurements. The length for a leg is the total of the lengths of each of the distal four segments (femur, genu, tibia, tarsus) disregarding the pretarsus, and the breadths are the greatest width (usually the height) of the tibia.

SYSTEMATICS

Section **PLANOFISSURAE** new name

Diagnosis (Adults)

Comalida. Holosomatina. Gnathosternum with dicoxal fissure usually present. Leg trochantera pedunculate with pedestal (on legs I and II comprising most of segment) encompassed within acetabular cavity. Tracheae usually opening into



FIGURES 5–8. *Constrictobates lineolatus*, female. 5, integumental striations and structures around setae *j*2, *J*3/*Z*4, *Sa*1; 6, right legs I-IV, femora/tarsi — posterior aspect, trochantera — dorsal aspect; 7, various positions of pore and seta beside left anal shield; 8, proteronotal sensory seta (*z*2) with capitate (a) and clavate (b) forms.

some acetabular cavities. Leg genu usually less than quarter volume of tibia. Hysterosomal dehiscence line circumnotal.

Remarks

The Planofissurae is a well established taxon also known as the Circumdehiscentiae (Grandjean, 1954) or the Euoribatida (Balogh & Mahunka, 1979). I have previously considered it as an unnamed taxon (Lee 1985: 50), preferring to use the slightly more extensive Holosomatina (= Brachypylina: Balogh 1972), regarding the fusion together of the coxites into a single shield in the latter taxon as a more important evolutionary event. Also, the Plano-

fissurae has been difficult to diagnose because the form of the hysteronotal dehiscence line is obscure (unless an exuvial 'scalp' is present), the genu is sometimes large and the dicoxal fissure is sometimes secondarily lost or masked by a gnathosternal tectum. The recognition of the encompassing of the trochanteral pedestal as a diagnostic character state makes easy the identification of members of the Planofissurae, and even if the somal integument is opaque, the external absence of any substantial part of trochanters I or II is ascertainable. Therefore, I now prefer to have this monophyletic taxon as a named group within the classification. There is a considerable disparity between its large size (over 100 families) and the size of the Clinofissurae (Lee 1985: 50 — 6 families), the only other section within the Holosomatina. It has been given a new name to match that of its sister group and to emphasize its new lower rank. The Circumdehiscentiae is currently regarded elsewhere as one of seven cohorts within the Cryptostigmata (Johnston 1982), or as the Euoribatida, being one of two suborders of Cryptostigmata (Balogh & Mahunka 1979).

The Planofissurae generally includes two major groups; the Gymnonota (Pycnonoticae or Apterogastrina) and Poronota (Poronoticae or Pterogastrina). Previously I (Lee 1985: 49) reintroduced the use of Pherenotae for some members of the Gymnonotae. The Gymnonotae is further divided here so that the Planofissurae includes the following five subsections with their characteristic superfamilies: Pherenotae (Gymnodamaeoidea); Carinotae (Liacaroidea); Gymnonotae (Oppioidea); Pliconotae (Tectocepheoidea); Poronotae (Oripodoidea). This is intended to undermine a tendency in past classifications to represent the evolution of the Planofissurae as a linear progression from the primitive Pherenotae to the advanced Poronotae. It is possible that three distinct lineages or subsections were derived from the Pherenotae, two of them monophyletic (Carinotae and Gymnonotae), whilst the Pliconotae may have given rise to the Poronotae. Such a model may prove inadequate, but it currently aids the search for alternatives to using the Gymnonotae as a large, probably polyphyletic taxon.

Superfamily **ORIPODOIDEA** Jacot

Oribatuloidea Thor: Woolley, 1958: 870 (part).
Oribatuloidea Thor: Balogh & Balogh, 1984: 257.
Excentrosclerosae Grandjean: Travé, 1970: 209.

Nominotypical family-group: Oripodinae Jacot, 1925: 277.

Remarks

Dr R. A. Norton (State University of New York, Syracuse) has pointed out (pers. comm.) that Oripodidae is the senior valid name for any family grouped in the Oribatuloidea: Balogh & Balogh, 1984. The principal of co-ordination (Article 36, current Code of Zoological Nomenclature) requires that Oripodoidea is the senior available superfamily name and is valid for the taxon.

The Oripodoidea is one of the biggest superfamilies in the Cryptostigmata. No clear delineating diagnosis has been made for the adults. They usually have small fixed pteromorphs, but these structures may be either large and hinged or absent, and even the foramina (diagnostic of the Poronotae) may be absent. On the other hand, immatures may be diagnosed by being 'nymphes à microsclérites' (Grandjean 1954) later referred to the 'Excentrosclerosae' (Grandjean 1959). The replacing of 'Excentrosclerosae' by a superfamily name was considered by Grandjean (1959: 473), but he was concerned about the similarity of the included Mochlozetes to members of the Ceratozetoidea. Later, however, he considered (Grandjean 1960) that Mochlozetidae Grandjean 1960 were similar to Sellnickiidae Grandjean, 1960 and also, Travé (1970) added Parakalummidae Grandjean, 1936 to the 'Excentrosclerosae'.

Subfamily **PSEUDOPPIINAE** Mahunka

Pseudoppiinae Mahunka, 1975: 293.
Constrictobatinae Balogh & Balogh, 1984: 280.

Type-genus: *Pseudoppia* Mahunka, 1975.

Diagnosis (Adults)

Planofissurae. Poronotae. Oripodoidea. Oribatulidae. Proteronotal seta *z*1 shorter than *j*1. Lamellae usually absent (exception: *Constrictobates*). Hysteronotum pear-shaped, sejugal furrow extending anterior to bothridium (around seta *z*2), may be evanescent or absent across mid-line. Hysteronotal setae in 11–15 pairs (always 6*Z*), setose (may have small cilia), not as long as distance between bases. Two pairs of hypertrophied slit-like pores (*hf*3, *hf*6) present. Either two, three or four pairs of small multiporose foramina present. Pteromorphs, if present, inconspicuous. Intercoxite apodemes transverse, short, not crossing midsternal line or reaching margin of genital aperture. Genital shield with two or three pairs of setae (exception: *Phauloppiella* with 4*JZg*).

Remarks

Balogh & Balogh (1984) ignored the part of the original diagnosis stating 'One pair of very small

area porosae' were present and regarded *Constrictobates* as 'Sacculonotic', whilst this paper records three pairs of multiporose foramina (= areae porosae). Therefore, *Constrictobates* should be grouped in the 'Poronotic' Oribatulidae rather than the Fenicheliidae. The options were to either maintain the *Constrictobates* in the monotypical Constrictobatinae, to group it in the Pseudoppiinae or to disregard these subfamilies and place it in the large, diverse Oribatulinae. Relationships in the Oribatulidae are poorly understood and the maintenance of many small subfamilies is not advantageous, yet there is a group of genera including small species with few genital setae, an anterior extension of the hysteronotum into the proteronotal region and many hysteronotal setae. In order to recognise this group, Pseudoppiinae is considered valid and the Constrictobatinae its junior synonym. The delineation of this more extensive concept of Pseudoppiinae is open to argument. To follow the weighting by Balogh & Balogh (1984), the number of genital setae would be regarded as the most important diagnostic characteristic of the subfamily, but genera such as *Diphauloppia* Balogh & Balogh, 1984 and *Paraphauloppia* Hammer, 1967 with only two or three pairs of genital setae are excluded, whilst *Phauloppiella* with four pairs of such setae is included. This results from a weighting in preference of the number of hysteronotal setae because of differences in chaetotaxy (for example compare *Paraphauloppia*-3*J*, 5*Z*, 2*S* with *Senoribula*-2*J*, 6*Z*, 3*S*) as well as total number. The following five valid genera are included in the Pseudoppiinae: *Constrictobates* (see following); *Phauloppiella* Subias, 1977 (Spain-Pm); *Pseudoppia* Pérez-Inigo, 1966 (central Spain, east Pyrenees-Pm); *Symphauloppia* Balogh, 1972 (Bulgaria-Pm); *Senoribula* Mahunka, 1975 (Senegal-Ee near Pm). The three genera (*Pseudoppia, Senoribula, Symphauloppia*) originally making up the Pseudoppiinae are more similar to each other than to the distinctive *Constrictobates* and *Phauloppiella*.

Genus **Constrictobates** Balogh & Mahunka

Constrictobates Balogh & Mahunka, 1966: 559.

Type-species: *Constrictobates lineolatus* Balogh & Mahunka.

Diagnosis (Adults)

Pseudoppiinae. Hysteronotum with 15 pairs of setae (*S*2 absent), 3 pairs of multiporose foramina (*F*3, *F*4, *F*5). Sejugal furrow continuous across mid-dorsal line. Lamellae present but flattened (seta *z*1-*z*2). Minute, horizontal pteromorph bearing setae *Z*1 and *S*1. Three prosternal apodeme bases (*I, II,* sejugal) present. Anterior margin of genital aperture and acetabulum IV transversely level. Two pairs of setae on both genital (2*JZg*) and anal (2*JZa*) shields. Legs short (order of decreasing length: I, IV, II, III) tarsi only about twice genu length, three pretarsal claws.

Remarks

Constrictobates includes one species previously recorded only from Western Australia. It was established in the Oribatulidae and, after being grouped in the Fencheliidae by Balogh & Balogh (1984), is now returned to the Oribatulidae (see Remarks on Pseudoppiinae). The material from South Australia is described here and compared with type material to correct original description inaccuracies and indicate intraspecific variations. The South Australian specimens are smaller and usually have a few character states differing from the type series, but not in all cases.

Constrictobates lineolatus Balogh & Mahunka (Figs 3-8)

Constrictobates lineolatus Balogh & Mahunka, 1966: 561.

Female

General appearance and measurements: Minute to small, dull yellow brown, cerotegument inconspicuous (sometimes evident as a granular, translucent layer partly detached around leg bases or posterior somal margin). Somal setae, other than proteronotal file *j* and *z*, medium length but fine and inconspicuous. Somal integument covered in fine furrows forming a reticulate pattern (Fig. 5), but superficially appearing as longitudinal striae, with only limited smooth patches (rostrum, lamella region and a pleural strip on ventral shield lateral to seta *Sa*1). Idiosomal length 207 (25 *ex* Tamboore, 183-217); 213 (1 *ex* Ferries-McDonald Reserve); 228 (holotype and three paratypes). Appendage lengths (for 215, *ex* Tamboore)-I 88, II 72, III 68, IV 79; tibial heights-I 15, II 9, III 10, IV 10.

Prosternum: Mentotectum width variable, narrow (Fig. 4) to broad (=setal base distance *I*1-*I*1). First apodeme base conspicuous, beside apodeme bases some faint external ridges between coxite zones. Coxisternal setae with seven pairs on flat mid-venter (*I*2 large) and two pairs on lateral tecta (*I*3-pedotectum I, *IV*3-discidium).

Proteronotum: Rostral margin tripartite. Lamella flattened (regardable as costula) extends anterior to seta *z*1 and posteriorly notched between it and circumbothridial ridge, which has hyaline flap ventral to seta *z*2. Three stout setae (*j*1, *j*2, *z*1) all ciliate, conspicuous proximally on abaxial surface of *j*1, inconspicuous on *j*2 and *z*1. Seta *j*2 finer than

*z*1, but sometimes similar in length (not as Fig. 3). Fine furrows restricted to near seta *j*2 and shallow groove between setae *j*2–*j*2 (Fig. 5). Seta *j*1 at anterior end of short ridge. Seta *s*2 inconspicuous, fine about a third length of *j*2, ventral to *z*2. The sensory seta *z*2 varies from clavate to capitate (Fig. 8), with cilia in longitudinal files, and often fewer on globose head of capitate state, also transverse profile may be either circular or oval.

Opisthosternum: Genital shield only slightly anteriorly transposed into region between leg acetabula. Substantially unpatterned lateral strip on ventral shield (Fig. 5) abaxial to seta *Sa*1. Considerable variation in relative positions of seta *Sa*2 and pore *Saf* (Figs 4, 7), with commonest state on South Australian material being *Saf* parallel to and hardly extending anterior to anal aperture, whilst base of seta *Sa*2 about level with posterior end of pore (Fig. 4). Posterior setal pair (*Sa*3) on protrusion of ventral shield.

Hysteronotum: Reticulate pattern of fine furrows (Fig. 5) divided into mid-dorsal and two lateral zones by a more substantial furrow (Fig. 3), which merges anteriorly with the sejugal furrow. Some variation in length of 15 pairs of hysteronotal setae, seta *S*1 longest and stoutest, sometimes more than twice length of *Z*1. Pteromorph minute, sometimes blunt (Fig. 3), sometimes pointed, base of seta *S*1 central or biased. Three pairs of multiporose foramina small (*F*4 largest), raised rim, central 'blister' with 7–13 pores clustered in middle (Fig. 5), foramina *F*5 unusual amongst oribatuloids in positioning anterior not posterior to seta *Z*5. Anterior hypertrophied slit-like pore (*hf*3) conspicuous, posterior pore (*hf*6) as long, only small part visible from above (Fig. 3).

Legs: Legs short, longest (I, femur–tarsus) 41% idiosomal length. Tarsi particularly short (all less than tibia, Fig. 6), thick (breadth more than 50% length). Tarsus III with distinctive bulbous base. All femora anteroposteriorly flattened with shallow ventral flange, not bearing ventral setae (e.g. femur II, seta *v*, Fig. 6). Long flagellium solenidium on tibia I and II. Pretarsal central claw longer and more robust than lateral claws.

Somal inclusions: Ovipositor involuted tube length, 65 (soma 215), three lobes length 20. Bears 18 setae, subequal in size to each other, longer and more robust than proteronotal seta *j*2, proximal setae (*pg*) unusually distal in position with tips reaching bases of distal setae (*dg*). No eggs observed. One to three boli in each female, sometimes translucent and granular (? bacteria), occasionally unrecognisable fragments or spherical spores, rarely multicellular fragments.

Male

Measurements and spermapositor (otherwise as female): Idiosomal length 193 (25 *ex* Tamboore, 177–204), 216 (holotype). Spermapositor breadth (anterior-posterior, length shorter) –16, sclerotized bilobed shield length –13, bearing 12 very small (shorter than proteronotal seta *s*2) subequal setae.

Material examined

Twenty-five females (N1986193–N1986217) and twenty-five males (N1986218–N1986242), leaf litter under banksia shrubs (*Banksia ornata*), Tamboore (35°57′S, 140°29′E), 4.7.1974, D. C. Lee. Holotype male and three paratype females (Hungarian Natural History Museum), leaf litter under dry sclerophyll woodland (*Eucalyptus marginata* and *E. calophylla*), Mt Toolbrunup (34°23′S, 118°03′E), Stirling Ranges, 7.6.1953, G. F. Bornemissza.

Distribution

Australia (Aa). Western Australia; Stirling Ranges, dry sclerophyll open-woodland, 13 adults (types). South Australia; Ferries–McDonald Reserve, mallee-heath tall open-shrubland, 1 female/1 of 8 × 25 cm^2; Tamboore, mallee-heath tall open-scrubland, 39 females, 37 males /4 of 8 × 25 cm^2 (69 adults in one 25 cm^2 sample).

Remarks

Initially, the South Australian material was thought to be a new species. It has been established that this was because of inaccuracies in the original description of the only valid species and because of morphological intraspecific variation. The South Australian specimens are smaller than the type material but are similar enough to be grouped in *C. lineolatus*.

Important differences between the specimens and the original description are as follows: proteronotum with short rostrum (seta *j*1 close to, rather than well separated from *z*1); sejugal furrow complete; 15 pairs of hysteronotal setae (*J*5 and *Z*5 overlooked); three pairs of multiporose foramina (two pairs overlooked); two pairs of hypertrophied slit-like pores (*hf*6 overlooked); hysteronotal seta *S*1 twice as long and stout as *Z*1 (described as subequal).

Intraspecific variations amongst South Australian specimens (sometimes between right and left sides) as follows: pore (*Saf*) and seta (*Sa*2) beside anal shield mostly as first illustrated (Fig. 4), varies to three other positions (Fig. 7) of which one is as types (Fig. 7c); sensory proteronotal seta *z*2 usually capitate (Fig. 8a), sometimes clavate as on types (Fig. 8b); size of a number of setae varies (*j*2, *s*2, *S*1), usually smaller than on types.

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KARIARA VIEWS ON SOME ROCK ENGRAVINGS AT PORT HEDLAND, WESTERN AUSTRALIA

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This paper describes, through an analysis of rock engravings at Port Hedland in Western Australia, aspects of Aboriginal economic life and material culture in the area. The carvings were recorded on a 1953 expedition and interpretations are given based on work done then with Kariara and other Aboriginal informants in the region.

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This paper is an example of ethno-archaeological salvage research in that it attempts to preserve the opinions of some Aboriginal people of the Kariara (Kariera), Ngarla, Kurama, Pandjima and Njangamarda tribes of north-western Australia about some of the many rock carvings or engravings present at Port Hedland. These were cut into the rock by earlier generations of Aborigines whose ideas appear to have been sufficiently close to those still held today that Kariara people of the present generation are able to make interpretations of the intentions behind the ancestral work.

Simple images were cut into the flat hard lime rock surfaces which had been eroded during former higher seas. The subjects cover various aspects of Pre-Kariara people's cultural life, their economy, some of the animals upon which they depended for food, and also some dangerous ones faced during their endeavours to win a livelihood from the sea which confronted them with its relatively great daily tides. In the time available for study (recreation intervals over two months), a limited number of the hammered-in outline engravings were copied and there were some opportunities for discussions about them with the Kariara and other Aboriginal people of the wider Hedland area.

To them the old-time engravers were the Minjubururu or Axe-people. This we can link with the Njangamarda term *minjururu* applied to the black volcanic rock used for their own axes.

Two types of hafted stone tools appear among the engravings, both of which were recognised by the Kariara as still in use in 1953. Both are discussed not only for their modes of use but also for their special interest to archaeologists. The stone axes are discussed at some length both as presumptively Pleistocene tools and as ones used today. Resin-hafted discoidal flake stone knives, also still in use and having a history extending from over 30 000 years ago until the present time, are given particular attention.

Evidence points to the particular engravings at Port Hedland as being post-Mid-Recent in origin, so that the Pre-Kariara artists might have begun their work less than 3 500 years ago. It is reasonable to view the makers of these engravings as much like the Kariara of today. Rapid growth of Port Hedland as a shipping port since 1953 is leading to the loss of some engraving sites, and the surviving Kariara folk are losing many of their links with the past. Thus this paper seems warranted.

On 2 May 1953 members of the University of California at Los Angeles and Adelaide University Anthropological Expedition with Professor J. B. Birdsell and this writer, having concluded anthropometric and associated anthropological work at Marble Bar in Western Australia, journeyed by car to Port Hedland on the west coast to set up further field stations among the Kariara and other local tribespeople. At a point near Strelley we searched a granite knoll for Aboriginal campsites and implements but found nothing, save the remains of a baler shell near a very temporary rainwater pool, already dry. Continuing towards Hedland the spinifex *Triodia pungens* plain gradually yielded pride of place to heath-like types of shrub. Port Hedland was reached across a landscape of old estuaries and salt marsh lakes, many filled with mangroves. There are also older dune range shore lines with banks of lime-cemented sand.

The party was met by Mr Harvey Tilbrook, Native Welfare Officer for the Hedland area who, after we had settled in, took us to see some Aboriginal rock carvings on a site about 1.5 km beyond the then little town and situated on some of the smoothly-eroded hardened fossil dune banks to be seen opposite the small local Native Hospital, as it was then known.

The consolidated dune beds there are approximately three metres above the present-day normal highest tide mark and appear to have been swept over in the past by seas from both sides so that they

now form flat, smooth-contoured lime-hardened old coral or dune banks. Usually there are two parallel lines of them close together, with a depression between often filled with brown earth. In other places they appear conjoined as a single line of old dune. There are Aboriginal deposits in the brown earth, chiefly of pelecypod shells, identified by the late Bernard C. Cotton as *Tegillarca besalis* (Iredale). These are present usually directly on the hard surface of the dune. Where this brown layer has been eroded away or is absent, the smooth rock surfaces, extending for nearly 3 km along the line of these dunes, are covered with engravings made by Aborigines. Usually they are shown as lines hammered in with a partly grooved pecking technique as though first marked with a line of punctures and then connected to make continuous grooves. These grooves usually are from about 1.3 to 2.0 cm in diameter and in general depict the outlines of the subject, sometimes with additional lines to indicate decoration. The grooves are not very deeply cut and often have well-worn edges. Only in one small area were there any deeply cut, very fresh-looking ones which might have been long protected by an earthy covering. Figure 39 could be an engraving of the kind of tool used by the old engravers.

The carvings historically may not be very old and the engravings conform to the present contours of the surface, well exemplified in the case of one particular turtle figure where a slight erosion gutter has been incorporated into and affects the outline of its head. The subjects appear to belong to a pre-European period since there are neither figures of ships, nor other designs which could be assessed as foreign, with one possible exception, a female figure, described later in this paper.

The existence of the rock engravings at Port Hedland has been long known. Herbert Basedow (1925) showed some human figure carvings, and Frederick C. G. Rose (1950) depicted others. A detailed account by Frederick D. McCarthy (1962) reported on a great many of these engravings, working from an archaeological point of view, and his account should be consulted for detail. Similar rock engravings are described in *Western Australian Museum Special Publication* No. 2 (Ride & Neuman 1964). It is devoted in great part to the story of Depuch Island off the coast near Port Hedland. I. M. Crawford therein illustrates rock engravings from that island, some of which are similar to the Hedland ones, but others are styled as stick figures. Some of the Depuch engravings represent humans in action, often carrying spears. Such designs were not generally evident in the area of the present study, which tend to be of static figures. It is unfortunate that there were no Aborigines surviving on Depuch to help Crawford in his understanding the engravings. They may not be contemporaneous with the Port Hedland ones. A drawing shown by Crawford (1964: Fig. 7) described as an 'elaborate opening scene, Hunter's Pool' seems to me to match closely the description of a dugong-spearing as given independently by my informants. It shows the long spears, some barbed, and the ring of armed men about an already speared animal. The marine hunting way of life thus appears to have been much the same as today.

The Port Hedland Engravings

At first, work on copying the rock markings was confined to the area near the Native Hospital where we began anthropometric work and a rough tabulation was made of one area, but circumstances led to some random copying of interesting designs elsewhere, and of ones to which our attention was directed by Aborigines. The following list thus is based only on the majority of the recognisable designs present in an area roughly estimated as some 50×500 m, made irregular by the presence of several temporary Aboriginal camps for people attending the Native Hospital. In the list relative numbers of carvings could be of some interest as showing the general range of the various artists' thoughts:

Boomerang (plain silhouette) (as Fig. 19)	18
Boomerang (decorated) as Fig. 28 etc.	15
Spearthrower (decorated) (as Fig. 14)	3
Spearthrower (plain)	1
Shield (decorated) (as Fig. 1)	4
Shield (simple meander figure on it)	1
Spear (as Fig. 7 etc.)	3
Snake-like design (as Fig. 80)	1
Turtle (as Fig. 73)	4
Shark (as Fig. 84)	2
Ray (as Fig. 75)	1
Bird (as Fig. 59)	1
Bird tracks (as Fig. 66)	11
Kangaroo or euro track (as Fig. 93)	4
Wallaby track (as Fig. 94)	1
Man (as Fig. 48)	1
Bar and lines (as Fig. 99	13
Designs, complex and indeterminate (as Figs 102, 103, 111, etc.)	17
Axe-sharpening marks	19
Meanders of 2 lines	2
Meanders of 3 lines	1
Meanders of 4 lines	2
Concentric circles (as Fig. 103)	1
Parallel lines (as Fig. 112)	2
'Scraped sticks' (as Fig. 107)	15
Circle (crossed) (as Fig. 113)	1
Fat bodies of fish (as Fig. 76)	7
Human foot tracks 4-toed	3
Human foot tracks 5-toed	2
Human foot tracks 6-toed (Fig. 51)	1
Human foot tracks (indeterminate)	1

As noted, the engraved designs which are illustrated in this paper were not all obtained from the one area near the Native Hospital. Some were selected from several wider areas within the township limits. There was one strange engraving, that of a female figure (Fig. 132) which appeared to be 'foreign'. It is unlike any others I have seen from anywhere in Australia. Strange elements in it include emphasized female breasts with the nipples duplicated, perhaps implying views from two directions. It could be a late accession. Publication of the figure could be considered of dubious value, but perhaps if shown might lead to discovery of further data on its origin. The design was clear cut and the edges of the cuts were sharper than in the generality of the other rock carvings, hence there could be room for debate as to its time of making. Some anthropologists perhaps would wish to ignore such a 'foreigner' — but it did exist in March 1953 and should be noted. Local opinion ascribes it not to Aborigines, but to someone of a small group of American soldiers belonging to a Navajo special unit that was camped close by during World War II. It is the only engraving considered possibly to be of non-Aboriginal design.

Kariara Country: an Outline of Their Life

Kariara country extends along the coast from north of Port Hedland west and south to beyond the Yule River. Inland it goes south for at most 150 km to where, in the Yule headwaters, the people meet the Njamal tribesfolk. For further details of their boundaries, see Tindale (1974: 344).

As far back as Kariara tradition goes they have lived at Port Hedland, and very old men talk about early events which had come down to them, of a time before white men had first appeared from the northeast. Malayan fishermen had been working along the coast, seeking trepang even before the first white men had arrived. According to local information, the nearest Malayan anchorages had been in the vicinity of La Grange, particularly at False Cape Bossut in Karadjari country. This was over 400 km away to the north-east. Some Malayan vessels had made visits to the Port Hedland area but there had been little Kariara contact with them.

In terms of the far earlier postulated arrivals of men in Australia, down the ancient corridor across the lowland Sahul Shelf from New Guinea during periods of lowered sea level in the Late Pleistocene, the land of the Kariara was about as remote from the ancient Asian doorway to Australia as could be envisaged. However, according to their own stories they had been subject to pressure from the eastern Desert interior. People now known to them as the Njamal had forced their way to the sea near Strelley, thereby cutting the Kariara off from their kindred folk, the Ngarla, who live along the De Grey River. Although now separated they still speak kindred languages and are alike in not having succumbed to the initiatory rites of circumcision and subincision brought in by the Njamal and urged on them with great force by the newcomers. In spite of this pressure both Ngarla and Kariara had resisted adoption of any of the secret rites common to these newcomers out of the Desert to the east. From a quick reading of the evidence in the present-day Kariara way of life, their social organization and even their language reflect their isolation, but it is clear they still have had to defend themselves against invading customs.

Some of these ideas were already old if looked at in terms of social organization to be seen in some eastern parts of Australia. The Kariara had adopted, for example, along with many of the other people living on the western coast, the four-section system of social organization, and had abandoned some of the ideas which continued in the extreme south-west, such as the still little-understood kinship system that prevailed near Perth. This switch to the four-section system had been present long enough for it to become locally adapted in many tribes, with some well-rooted changes, so much so that, even within the northern and southern hordes of the Kariara, there were special adaptations, details unnoticed by Radcliffe-Brown (1930: 208) who had come to the view that it was indeed the model for the four-class system. Actually the model he set up is really the form of the system practised today by the adjoining Ngarla tribespeople. Be that as it may, the Kariara in the days when white people first appeared were defending their mode of initiating their youths into adult life without the secrecy of the rites of the men of the Njamal and other inland desert tribes. These desert tribes had adopted the rite of circumcision as a first rite performed in secrecy, away from their women, followed by a further, ultra-secret, second rite of subincision. These two initiation practices seem to have spread independently from the east as they found their way across the desert interior from the north-east. The second rite of sub-incision has usually caught up with the first, as among the Njamal.

The Kariara were faced with resisting the full impact of the Njamal tribe ways of initiation. However, despite their despised position in terms of their Njamal neighbours, they had been able to resist the new ways for some generations. Their southern kindred, the Indjibandi, had succumbed to the first or circumcision rite under pressure from people like the Bailgu who also, coming from the east, had attempted to exert pressure on the coastal people. The full significance of these fundamental life differences is well shown by the lines on the 1974 tribal map published by this writer.

As weapons of defence, the Kariara have only barbed spears with barbs affixed with resin and/or with sinew lashings. These are also their principal hunting weapons. The desert Njamal folk more often use simple, often slightly swollen-headed throwing clubs for most of their hunting needs, spinning them as they attack their prey, reserving their spears, of which they possess many, for use in contention and in acts of aggression. Often the spears are armed with resin-affixed terminal stone-heads instead of the merely affixed lateral barbs of the Kariara spears. The Njamal also use a different spearthrower. On the basis of the engravings on the Hedland rocks it would seem that the Kariara inherited inferior types of spears from their Pre-Kariara ancestors.

Although thus disadvantaged, both the Ngarla and Kariara have been able to resist adoption of the dreaded secret rites, retaining the simpler, openly displayed ['tjilimindi][1], or arm-binding, and hair-plucking ceremonies of their past to mark the changeover of their youths from boyhood to manhood. However, their southern kin, the light-skinned and blond-haired Indjibandi of the Fortescue River, had been forced, or enticed, in recent years to accept the rite of circumcision. One old Kariara man complained bitterly to us that lately, by making offerings of brides, Indjibandi men had enticed one or two Kariara youths to accept the first secret rite, thus depriving the Kariara of their own men.

Openly displayed as rock engravings at Hedland are some of the decorative symbols, concentric circles and spiral designs, held as secret by inland tribes along with such tools as ['tjimari] or resin-hafted, discoidal knives as used in their initiatory operations. The last named, the *tjimari*, is the instrument for their circumcision rite and is considered to be a particularly important secret object to be produced only at men's ceremonies. Openly displayed as the symbols are at Port Hedland, they cause worry among Njamal, Njangamards, and Bailgu tribes visitors who had discovered them. They might be seen by their women. To the Kariara, however, such engravings remind them merely of openly used paraphernalia of their own initiation days. In discussion they suggest that the initiation rites of the Pre-Kariara artists must also have been open to viewing by both sexes.

Until the changeover to employment as cattle station hands, and more recently as gatherers of rare earth minerals, the Kariara of Port Hedland area were exploiters of the life they found in the sea. They had no watercraft, and walking in water up to their armpits was a limiting factor in their efforts. Fish-spears, held javelin-like, were used, providing one of the principal ways of obtaining their fish foods. Sometimes a man's javelin-like weapon was linked to his body by rope made from human hair, one end tied around his waist and loops caught under it, ready to be played out as the fish, or other marine creature, was lanced and, trying to escape, dragged the fisherman about until it succumbed. Daily tidal changes enabled the Aborigines to use several other special ways of fishing. One method involved the use of special fish-killing weapons of heavy wood, of boomerang form but biconvex in section. These could be thrown at their prey, usually one of the larger fish, even one as large as a shark, or at a marine mammal, such as porpoise or dugong, especially at times of high tide. If a cast was unsuccessful, the weapon could be retrieved readily at low tide. Nets for catching fish were hard to come by and in the Kariara area came usually in trade from the northeast. According to my informants this was only for lack of local fibres suitable for string-making. Women's hair was the only useful and ready source of fibre for string. An important way of trapping fish, as substitute for netting them, was by using teams of men and women to push walls of beach vegetation through the water surrounding their prey, generally at particular places in estuaries and channels where there were suitable coves or banks against which to trap the animals.

The Kariara People and the Rock Engravings

Kariara interest in the rock markings was apparent when we met our first Aboriginal informant, an old man named ['Kundjiŋ]. He immediately recognised an engraving I had copied (Fig. 92), calling it ['kadarabaga], a whale. Then he discussed two boomerangs (Fig. 18 and 19), saying they were ones used as fish-killers, and that the human figures depicted (Fig. 45 and 48) were of men; others were of women. He recognised the saw-shark as ['irawari], noting that this big fish came into marine lagoons and water channels at high tide and could be speared or killed with the aid of boomerangs. Twelve circles clustered together (actually 13) were a nest of emu eggs (Fig. 69). Figure 14 was the engraving of a decorated spear-thrower ['walbara], of the kind he called ['bilbinj]. With the help of this man and other Kariara it became possible to interpret and give names to many of the rock engravings.

Kundjing ascribed the engravings at Port Hedland to ['Minjubururu], the stone axe people, who were 'people like ourselves'. Traditionally the Minjubururu came from the south, long ago, and looked for water at Port Hedland. Many died there. Some *Minjubururu* went to Depuch Island. He said that 'Kariara Aborigines cannot get there now, but in the afternoon one can see them on the island. We can't get to them.' The last statement was obviously in his imagination, an allusion to the

former existence of Aborigines on that island as evidenced by smoke and other signs of living.

Like the Kariara, the Pre-Kariara artist-folk can be inferred to have been a shore-dwelling people who obtained much of their sustenance from the sea. They were relatively sedentary since the demand of the rise and fall of the tides, here relatively great, must have determined their daily round of taking fish and other foods from the sea and from the tidal mangrove swamps that surrounded them. They tell the story of these activities in the engravings they placed on the surfaces of their seaside dwelling places. Their artistic attention was focused to a relatively great extent on their weapons for defence and on the ones for the gathering of food. This interest also extended to the most spectacular of the marine creatures, ranging from whales, *kadarabaga*, the dugong ['njamina], sharks ['ira'dananga], and even to the fresh-water perch ['jurda], which they could take in the Yule River. Other than marine products, emus and their nests of eggs, and the birds which they struck down by launching boomerangs at passing flights, provided ready subjects for their artistry.

There are interesting touches from which we can learn, such as the frequent depiction of the fat-bodies on ray-like fish reflecting a special desire for fat, similar to the cravings of Central Desert men, like the Pitjandjara and Ngadajara, for fat bodies of kangaroos and the fatty meat of dingo pups.

Undoubted similarities are to be seen between some of the present-day drawings (Figs 115–131), made for us by Kariara and by kindred tribesmen, and the rock art figures. Indeed it seems safe to assert that there has been a continuity of tradition of some duration, perhaps even for more than a millenium of past residence there by Kariara-like people.

Comments on the Engravings

Figures 1–6 were identified by Kariara informants as being of shields, or ['jata]. Present-day ones are often carved from the relatively soft wood of *Brachychiton* and may also be from *Adansonia* trees. The wavy patterns carved on the engraved shields are still displayed on both Kariara and Pandjima *jata* (see Figs 123 and 128). Woods suitable for weapons are everywhere hard to get in Kariara country and one of the first tasks of a newly initiated young man was to begin a search for suitable trees from which to take his weapons. Readily accessible trees in clan territory were all claimed as potential sources by others, hence he had to search in remoter parts of the tribal territory for suitable hard woods for clubs, spears and boomerangs, and for lighter woods to make shields. Disputes were readily aroused when an older man claimed that this or that tree or shrub had already been touched, and thus claimed as his own. Kundjing, our Kariara informant, made a drawing of a Kariara shield as Fig. 123 and Ngoera, a Pandjima man, made one of his own people's ['jandijiri] shields from the Hamersley Ranges (Fig. 128).

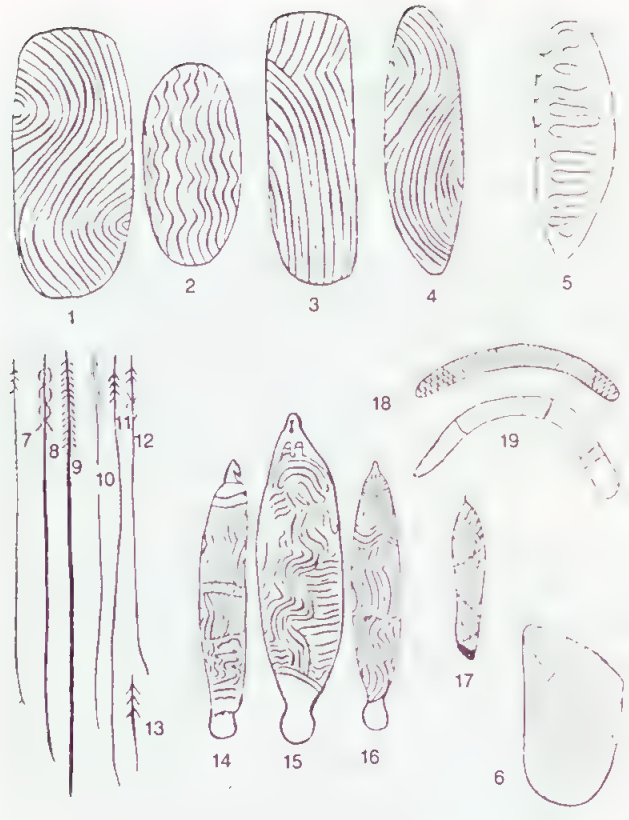
Spears of the Kariara that were used in serious fighting could be armed singly or serially with stingray barbs and spines of other fish set in resin. Wounds inflicted with them were considered to be poisoned, and in their traditions, all things from the sea were considered dangerous. They have a saying about this: ['Kutuŋuru 'kapa 'meida wiriwani] (sea/from/do not/play with it).

Several kinds of spears were used in fishing, both in the Yule River and in the tidal estuaries. These constantly active tidal streams carried deep water inland because of the high tidal range, and the spearing of dugong or *njamina* gave them their most favoured source of meat. Taking advantage of these tides, men armed with extra long pole-like spears watched the water as it flowed up an inlet. They tested the water flow by throwing leaves on to it. When the inflow ceased at highest tide they set nets, called ['parubaru], bracing them with the poles while men armed with barbed spears awaited the chance of spearing an entrapped animal. At low tide they could readily recover and repair their nets. This description of dugong hunting, developed from Aboriginal descriptions, was later noticed to closely fit a rock engraving which was recorded by Crawford (1964; Fig. 7, p. 59) on Depuch Island off the Kariara coastline.

Kundjing could see little difference between the engraved spears shown as Figs 7–13 and the familiar ones of his own people, for which he could remember no fewer than seven different names, chiefly depending on the types of armature. Figures 115–122 are of pencil drawings he made and brought to me to illustrate his own recollections of and names of the several Kariara types. Although they may seem different in our eyes, this may be due to our interpretation of differences in what he saw as resemblances.

According to other Kariara helpers the spears shown in Figs 7–13 were similar to ones they threw, using spearthrowers as aids in launching them. Theirs were multibarbed and the barbs were attachments. The latter could be of stone, shell, wooden points, or stingray and other fish spines. The resin ['waruba], derived from spinifex (*Triodia*), held the barbs in place. Stingray tail spines were used as tips for some spears.

Bifacially worked pressure-flaked points called ['tjimbila] came, on rare occasions, as traded objects from the north-east. The informant did not know where they came from, but they had for long been



FIGURES 1-19. Port Hedland rock engravings. 1-6, shields, *jata*; 1, length 130 cm; 2, not measured; 3, length 81 cm; 4, length 81 cm; 5, length 66 cm; 6, 33 cm. 7-12, spears, *talamara*; 7, length 110 cm; 8, length 150 cm; 9-11, not measured; 12, length 91 cm; 13, spearhead; 14-17, spearthrowers, *walbara* also called *bilbinj*; 14, length 91 cm; 15, not measured; 16, length 76 cm; 17, not measured. 18-19, fish-killer *waruwaru*: length 53 cm and 38 cm.

ascribed to ['Waijuŋari], a mythical man who also came from the same easterly direction. A few Kariara men had placed them on their spears, but 'only for show'. When white men first arrived, appearing from the same direction, they fell heir to the name Waijungari, and Kundjing recalled the beginning of a song about the pressure-flaked blades: [Tjimbila:na waijuŋari] (repeat).

Tjimbila blades were not shown on any of the Pre-Kariara engravings of spears, hence there is a possibility they began to arrive only after Pre-Kariara days. A Njangamarda man said that in their country, further to the northeast, *tjimbila* points came regularly in trade. With them came a special very long spearthrower known as a ['ŋabalinj], also called ['ŋabaliŋ], and illustrated in Figs 129-130. *Tjimbila*-armed spears launched by *ngabalinj* were much dreaded — the reason: 'One cut and you bled to death'.

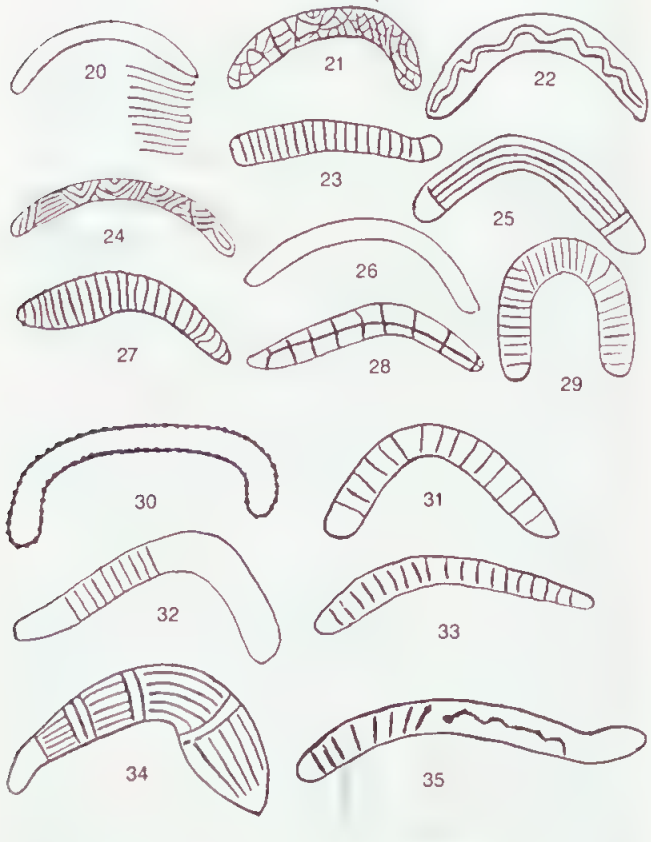
In the days when white men were fighting with Aborigines, this informant said, the police ordered all *tjimbila*, many of them made from introduced bottle glass, to be destroyed, and they confiscated all spears armed with these Kimberley blades.

It should be noted that in South Australia among the Jaralde the name Waijungari is that of a skilled ancestral spearsman, son of their great being Nepele. Waijungari, newly initiated, escaped with two of his father's younger wives and fled to the heavens, as told in a detailed myth (Tindale 1935). At the present time it is difficult to imagine any direct link between these two far-separated uses of the name Waijungari among people living over 2 500 km apart. If proof of substantive relationships were to emerge, it would surely imply that the earlier counterparts of the well-known Molonggo, the Kurangara, and similar travelling ceremonies, such as those which accompanied baler shell ornaments for spearthrowers from Cape York Peninsula to Winton in Queensland, and even as far as the Lower Diamantina area, had the power to carry ideas and words with them. Pearl shells from the vicinity of Broome, similarly, but perhaps in less organized fashion, are carried even as far as Ooldea (Tindale, in press). Such inter-tribal exchanges perhaps have had greater influence on cultural shifts and introduction of new ideas than some have suspected.

Spearthrowers depicted by the Pre-Kariara people, as in Figs 14-17 were recognised by Kariara men as being similarly shaped, with a peg orientation the same as in their own spearthrowers or *walbara*. It called for the use of a particular grip in holding spear and spearthrower in position for launching the weapon. For this the handle end of the *walbara* is held between the thumb and index finger and firmly gripped against the palm of the hand by fingers 3, 4 and 5. Tips of the thumb and index finger support the spearshaft so that the peg of the spearthrower rests firmly in the hole in the butt of the spear. This may be known as Method A. It is widely used in southern Australia. The method they do not use, but which is widespread in the northern parts of Australia, involves the holding of the spearthrower between the index finger and the middle one. This requires not only a different shaped body for the spearthrower but also a different orientation of the peg. This second grip I am calling Method B. The latter is linked in complex fashion with the use of composite spears with head, shaft and slightly angled butt piece, each junction lashed with kangaroo sinews and resin coatings. Its employment enables the spear user to keep his forefinger free to take part in an action assisting the development of spin in the spear as it travels towards its target.' Having had opportunities to study the methods and distribution of these spear-projecting ways over much of Australia, I have a study in preparation giving support for this preliminary statement about spearthrowers and their use. As is well-shown in my unpublished film on Kimberley blade-making and

use at Moolabulla and the parallel published description, Tindale (1985), the Method B grip is present among the Djaru and Kitja tribespeople and widely used also in the northern interior of Western Australia. Figure 124 drawn by Kundjing shows the Kariara spearthrower, and Figs 129–130 by Mekata of the Njangamarda tribe shows the long-shafted *ngabalinj* they receive by trade from the Mangala, who in turn receive them from the Walmadjari people of the Christmas Creek area, whom they know as the Tjiwaling folk. The *ngabalinj* requires the use of Grip B.

Boomerangs as weapons were evidently important to the early Pre-Kariara artists as also to our Kariara informants who considered that among the boomerang engravings they could recognise several different types similar to ones they use. The main one used for fighting was their ['wirba], a distinguishing feature of which seems to be its having the end held while throwing it, slightly longer and less wide than the forward end. Such a boomerang would be identified by marks the owner placed on it. My informant recognised among the Hedland engravings right-handed *wirba*, like Figs 33 and 35, and left-handed ones, Figs 32 and 34. Men who went seeking a fight might carry an armful of *wirba* to combat. Figure 20 was suggested as indicating such a parcel of boomerangs. A comment about this set was that the left-handed owner had not placed his identifying marks on the bundle.



FIGURES 20–35. Hedland boomerang engravings, *wirba*. 20, length 41 cm; 21, length 53 cm; 22, length 41 cm; 23, fish-killer, *waruwaru*, length 43 cm; 24, length 48 cm; 25, not measured; 26, length 53 cm; 27, fish-killer, *waruwaru*, length 46 cm; 28, left-handed returner, *wakundi*, length 46 cm; 29, length 25 cm; 30, length 48 cm circular holes are subsequent; 31, fish-killer, *waruwaru*, length 38 cm; 32, left-handed returner *wakundi*; 33, fish-killer, *waruwaru*, length 43 cm; 34, left-handed returner, *wakundi*; 35, right-handed returner, length 51 cm.

Bird-hunting boomerangs ['wakundi] were made so they would return to the thrower if they missed their target when thrown into a flock of birds circling to land. It allowed the quick retrieval of such weapons. Opinion was that Figs 28 and 31 were engravings respectively of left- and right-handed *wakundi*.

A special boomerang called ['waruwaru] by the Kariara was employed in fishing and could also be used as a weapon in close 'arm to arm' (their wording) quarrels. The *waruwaru*, also known as ['waruku:ndi], was thrown at large fish, such as sharks, and other animals when seen in the water. It had special characteristics and was important in marine exploitation. It was thrown to enter the water spinning vertically, and was bilaterally symmetrical, i.e. had a biconvex section. Such boomerang-like weapons were made of the heaviest of woods so that they would sink and not drift away. They could be reclaimed when the massive tides fell, leaving the area dry. Figures 23, 27 and 31 were ones considered likely to have been intended as representations of *waruwaru*, and Kundjing drew, as Fig. 126, his concept of their own Kariara one. Similar heavy wooden boomerangs for fishing have been used as far away as at Port Lincoln in South Australia, among the Pangkala tribespeople. In post-contact time examples made of metal cut-outs have been used.

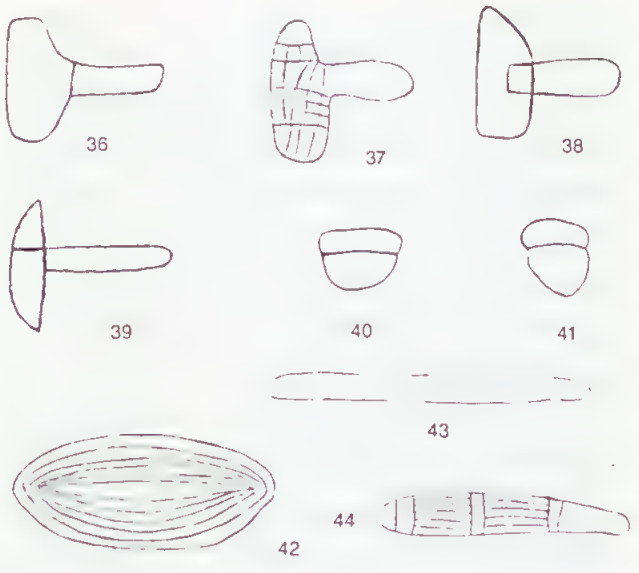
Representations of hafted stone axes appear often among the Port Hedland engravings. Perhaps they were highly treasured objects. Kariara men considered them good depictions of their own ['bulbu] which they said (in English) were always made of 'steel stone'. The present-day Kariara hatchet has a split withy wrap-around handle bound with kangaroo leg sinews ['talbara], since dingo sinews are too short to be useful. The stone was fixed in the loop of the haft and the lashings held with *waruba* resin which was gathered from spinifex. To obtain this resin the Kariara beat matured clumps of the grass on a hard surface and sweep up the resin flakes and winnow. By holding burning twigs over the dish of flakes they carefully melt the resin at the lowest possible temperature. A bluish smoke indicates over-heating, rendering it brittle and useless. The melted resin is gathered up on a stick to form a ball ready for use.

Kariara axe stone came to them by trade from the northeast beyond Njamal country. Each block

had to be edgeground to make a cutting edge by rubbing it on hard rock surface such as granite. It happened that Windaru, an aged Njangamarda man from further north, who was visiting the Native Hospital, was with us on one occasion and heard Joseph Birdsell remark on the seeming shortness of the handle of an axe depicted in one of the engravings (Fig. 37) that we had just noticed. The old man's response, using his own name for the axe, was brief and to the point — 'Heavy ['ma:di], short handle'. The present-day stone tomahawks tend to be smaller and have long handles. Another Njangamarda man of the coastal country further north said that their *maadi* axes were made from ['minju'ru:ru], literally his 'black stone', which came by way of trade from the hills southeast of ['Jalajala] or Eil Eil Spring. Thus it may have been traded to Port Hedland from more than 300 km away. The engravings of axes unfortunately do not tell us much about the work done on the axe heads during their making, and whether or not the hafting was held in a groove. The presence of heavy axes with short handles might suggest that more and heavier timbers than grow nearby today were available locally in Pre-Kariara times.

Figures 40 and 41 were pointed out to us as representing resin-hafted discoidal stone knives called ['tjimari] or ['jimari]. One was depicted as larger than ones used by the Kariara people today. Both sexes could use them for general purposes as unifacially knapped knives with resin handles. Since good chert was not locally available, women often used instead a similarly shaped *Cyrena*-like bivalve shell for their food preparation work. The situation was different among the inland tribes to the east and south, particularly the Njamal, Njangamarda, Niabali, Indjibandi, Kurama, Pandjima, and Wanman who, using the stone flake knives in their secret rite of male circumcision, have come to regard the *tjimari* as one not to be seen by women. In several papers, particularly Tindale (1957: 15; 1965: 143; and 1985: 28) I have reported the discovery of the various surviving uses for this knife, which is of special interest because it is recognisable as one of the principal tools found archaeologically in horizons as far back in time as the 30 000 BP era in eastern Australia, as well as being one of the dominant tools of the Newer Tasmanian culture. It was one of the cutting tools of the Tartangan culture phase (of Hale & Tindale 1930). There is further discussion of this *tjimari* tool in the concluding part of this paper.

It will be noticed that while very many of the rock engravings are of items and subjects of interest particularly to men, a few relate to implements used by women. Perhaps there was some bias since the informants did not recognize all of the designs. It happened that they all were males. One engraving



FIGURES 36–44. Hedland tool-engravings. 36–39, hafted edge-ground axes, *bulbu*; 40–41, resin-hafted discoidal flake knives, *tjimari*; 40, diameter 18 cm; 41, diameter 9.5, of resin handle 10 cm; 42, wooden dish for winnowing; 43, beater for opening termite mounds, length, 74 cm; 44, throwing club *wambu* (Ngarla name), length 61 cm.

(Fig. 44) was recognised by them as a ['lumba] or beating-club such as used by women in breaking into the numerous tall meridionally-oriented termitaria present on the *Triodia* grass-covered plains situated a little inland from the coast. Termites, called ['maladja], were one of the foods gathered by women, using wooden dishes, called ['tjardu], to separate termites from the soil by rocking and winnowing techniques. Figure 42 was interpreted as an oval-shaped *tjardu* with riffles cut into the surface to assist in the effects of the tapping, rocking and other manipulations which help clean the product and yield a whitish mass of crushed termites used as food. Such dishes were used also by men in winnowing resin for their weapons.

Human figures were not common in the carvings of the area near the hospital and did not seem to display the same considered detail of some other carvings. Figure 45 was thought by Kariara informants probably to represent a youth. Taking note of the differences in the arms of the boy the informants believed him to be in the stage of initiation when he was undergoing an arm-binding rite. His left arm was interpreted as being badly swollen by too much pressure while the right was lean and firm-muscled, as was proper. Following up this lead we obtained details of the Kariara initiation. When a youth is about 14 or 15 years of age he is seized as a ['malulu] by a group of men who became his ['mamia]. In their four-section system of social organization, if the boy is a Paljeri or a Purungu his *mamia* are of the opposite moiety (Karimara and Panaka), who call him ['piruwaŋ].

The men of the boy's own, the inactive moiety, become his ['kaŋu] and they call him ['walara].

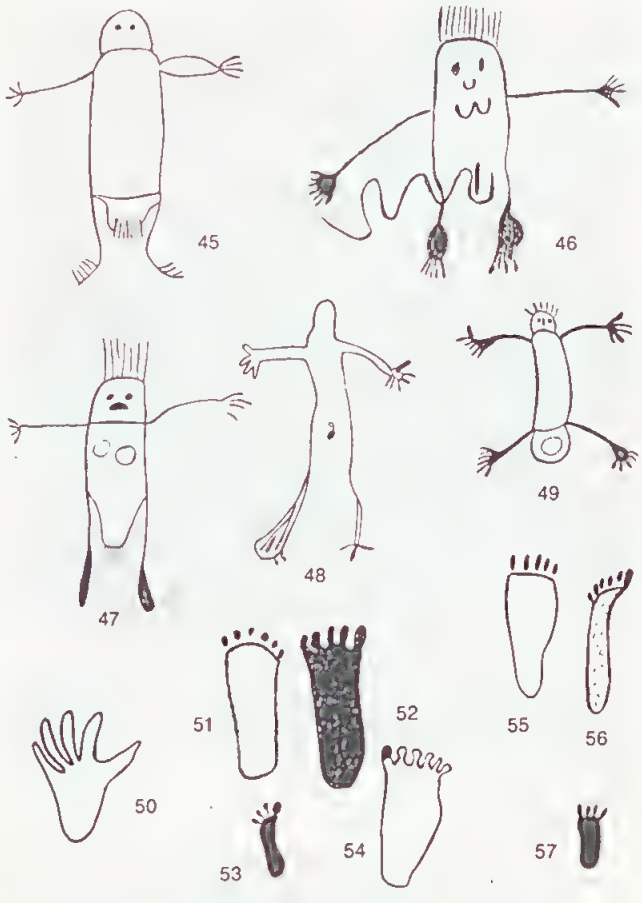
The *mamia* take their *piruwang* on a tour through their country during which he is told much about the history and the names of places and he also learns of the responsibilities he will be assuming as a man. At this stage the boy wears a small pearl shell ornament ['pira'pira], suspended from his neck, and another over his pubic area. Messengers with him ask people of other hordes of the tribe (met during the *malulu* journey) to assemble at an arranged time and place for dancing displays. Meanwhile the *kangu* men remain at home working, particularly through their women, building up food supplies against the day when the *mamia* party returns and other invited people arrive. Then there is a ['pundulu], or feast, with singing. Men seat themselves in the centre holding the youth (or youths if, as is usual, more than one faces initiation at the one time). Women dance around the men on the outer side of the circle. This is the climax of their share in the proceedings. Then the *mamia* continue on a second stage in their travels.

The youth during further travel has to undergo the beginning of the ['tjilimindi] or arm-binding ordeal. During this ceremony the men who are his *mamia* sing:

[Tjilimindi	mindi	wawila	tora:[2]	kulbarba	tanai
Armbands		winding	blood	swelling	
kulbarba	tjana:]				
swelling					

Strings made from the fur of the ['wadjiwara], or kangaroo rat, are wound tightly around both of the boy's upper arms and are left for 'six days' and then taken off. If the arms swell too much the bindings are slackened a little. During this stage he is a ['wamuli]. His hands become numb but he is compelled to keep 'travelling on'. He is not allowed to swim. When they come to water the youth is carried across it, for the arm bands must not be allowed to become wet. When these bands are removed his muscles are supposed to be small and solid and he is so strong than he can throw a boomerang very far. The youth is painted with red ochre and is shown the secret of the bullroarer ['kuli:di]. He is now ['maijaga], a man. He makes a triumphant return to his people.

In the main there was little comment from the Kariara about the other human figures. Figure 46 was considered to be that of a woman and a snake. It was a visiting Njamal man who expressed the view that the artist had given an action picture of a ['kolibiri] or poisonous snake attacking a woman. This chances to be one of the rare Pre-Kariara carvings in which the engraving is not of a static situation but of a real life one. Among the other



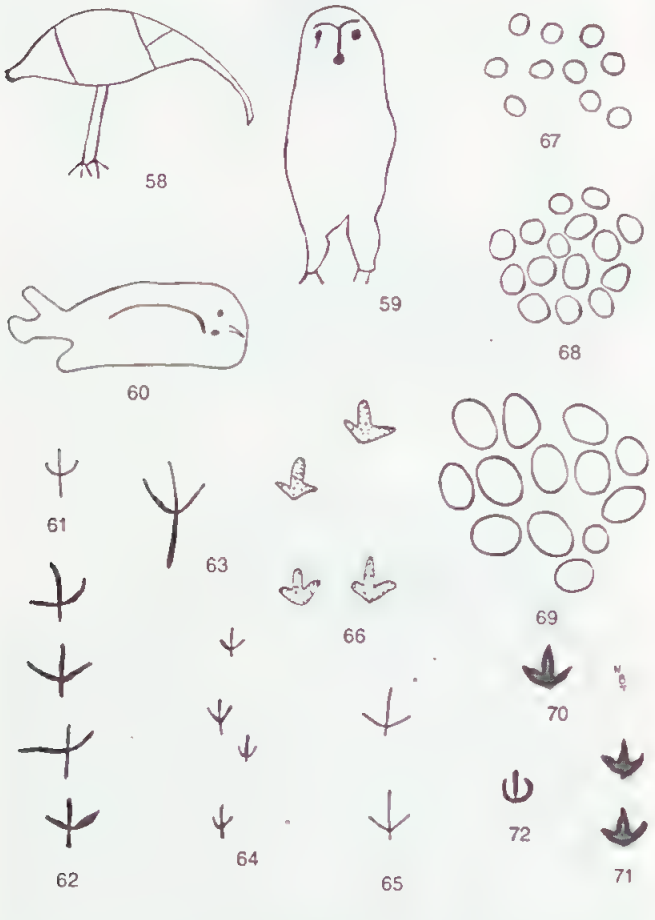
FIGURES 45–57. Hedland engravings of humans. 45, man, considered a youth, undergoing the *tjilimindi* arm binding rite during initiation; 46, woman, *mana* and *kolibiru*, a poisonous snake; 47, woman; 48, man, *maijaga*; 49, girl child; 50, hand, *mara*; 51–57, footprints, *tjina*.

carvings Fig. 49 was believed to be that of a female child. The genital area happened to be carved around a pre-existing hole in the rock.

In the human figures and in the human tracks the depicted hands and feet have fingers and toes shown with much variation as to number, ranging from four to six. The Kariara had no explanation for these variations. In the case of footprints there seemed to have been no preference in depicting either right or left foot imprints. From the way the Kariara discussed the depicted foot tracks I gained the impression that they thought each of the engraved footprints was registering something special about some individual, recording peculiarities of gait and toe position that were important as aids to identification of individuals which could affect their own daily lives. What mother-in-law would willingly place her own track in juxtaposition to some registering movements of her daughter's husband, with whom she could never openly meet? One human and interesting point came out. Sometimes a distinctly shuffling gait, destroying the legibility of footprints, was a precaution taken as

a woman neared a 'dangerous place', one where such kin were likely to have left visible tracks.

The Pre-Kariara artists depicted birds, usually of the larger and more edible species, and their eggs. I received some help in identification. Figure 58 showed a crane ['ja:ngara], and its tracks were considered to be as shown in Fig. 62, while similar tracks, Figs 61, 64, 65, were thought to be those of ibis, more than one species of which live in the swamps. Owls, of which we found two engravings, are in some fashion linked with present-day stories, but I failed to follow up because of pressure of other recording. Kundjing, our first Kariara informant, recognized the subjects of Fig. 66 as a set of the eggs of the emu ['tjanguna]. In egg-laying season the emus were not molested, but the eggs were taken. At other times of the year emu and kangaroo were hunted, using fire to drive the animals toward strategically placed and concealed spearsmen. The eggs shown in Fig. 67, occupying a space some 30 cm in diameter, were believed to be those of ducks, but I did not follow the discussion as to which kind they might be. Emu tracks are commonly depicted (Figs 66, 70 and 71) and one solitary track, Fig. 72, was thought to be that of the bustard ['ranguritji]. The neighbouring Njamal people, who had access to better fibres for string, trapped the birds, making nets to enclose native plum trees, the fruit of which were very attractive to the birds. The Kariara were never able to do this netting for lack of the necessary string for making nets.



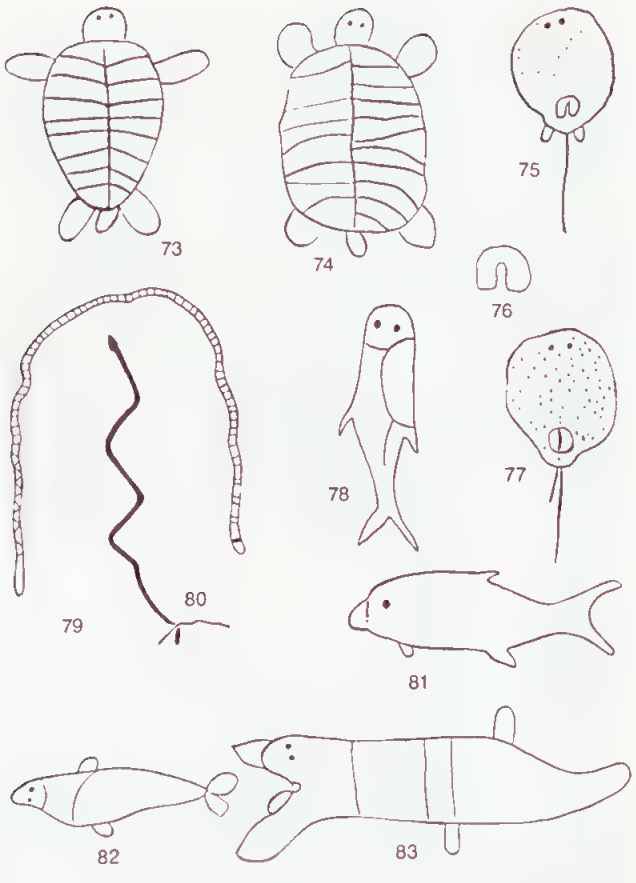
FIGURES 58–72. Bird engravings. 58, crane, *jangara*, length 66 cm; 59, owl, height 58 cm; 60, owl, length 28 cm; 61, ibis track, length 10 cm; 62, crane, line of four tracks, each about 20 cm; 63, 25 cm long, not recognised; 64, ibis tracks, group of four each, 7 cm; 65, ibis, part of line of ten imprints; 66, emu tracks, *tjangura*, set of four, length 9.5 cm, showing pecked hammerings; 67, duck eggs, diameter of setting 28 cm; 68, emu eggs, nest set of fifteen; 69, emu eggs, thirteen, diameter of nest space about 50 cm; 70, emu track, length, 18 cm; 71, emu tracks set of two, 25 cm apart.

All food animals played important roles in the thoughts and lives of the early artists of Port Hedland. We chanced not to copy any engraving of the large monitor lizards which were commonly depicted. Of the smaller lizards there were seemingly very few representations among the carvings. Such creatures today are chiefly gathered by women and children hence were perhaps not subjects for men's thoughts.

At all times these lesser animals provide a substantial part of the Kariara children's diet. With reference to the larger lizards, it should be mentioned that there is a carved wooden club in the South Australian Museum collection, specimen No. A 46268, received without data other than a general indication of having come from Western Australia. It came in 1964 from the estate of Mr H. Savage. Figures carved on its shaft include one of a monitor lizard, two human figures, and also one of an owl, one that is virtually identical with Fig. 59. These are so similar to the rock engravings being described here that it is difficult to believe that the club could have been carved by other than a Kariara man, one personally familiar with the very engravings present at Port Hedland itself. The work was done on the hardwood surface of the club, first by incision, and then finished by a burning technique. Perhaps this club should be regarded as providing an indication that the Hedland carved designs include some that are not very old, or alternatively that the old artistic tradition continued until a time as recent as a generation or two ago.

Snakes were frequently depicted by the Pre-Kariara artist. The supposed action picture shown in Fig. 46 has already been discussed. Figure 79 was interpreted as that of a python called ['maniara] and described as possessing a striped pattern and a black head. This type lives in swampy areas. There was another python known as ['palgumara] living in rocky places around permanent sources of fresh water.

Turtle figures were commonly engraved. Figure 73 shows one of normal size. It should be noted that, in general, designs adhere to expected sizes, however, Fig. 74 does depict a very large turtle, measuring far larger than usual. Although executed

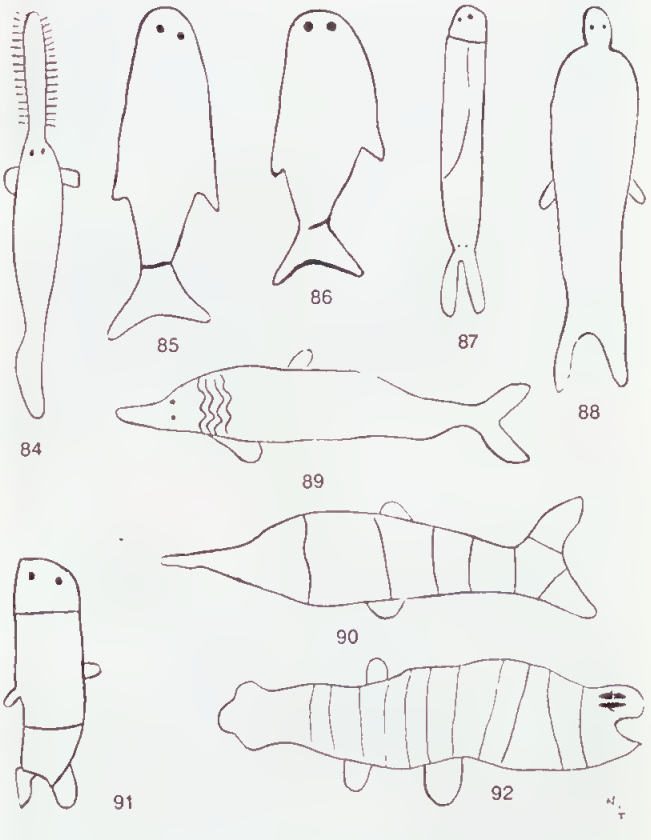


FIGURES 73–83. Reptile and marine-animal engravings at Port Hedland. 73, turtle, *tjatjaroka*, overall length 83 cm; 74, turtle, large, length 1.65 m; 75, stingray, body length 58 cm; 76, fat body of ray 13 cm; 77, stingray, body length 61 cm; 78, fish, 60 cm; 79, python, *maniara*, identified by its banding and black on head, length 3.35 m; 80, snake, not identified, length 94 cm emerging from hole; 81, fish, not identified, length 80 cm; 82, marine mammal, length of body 61 cm; 83, shark, *maritjawarin* of Ngarla tribe, length 2.5 m, supposedly benign.

by artists not in any way linked to each other, these two turtle figures are remarkably similar in execution. Both were considered to be ['tjatja'roka] by Njibiri, a man of the adjoining Ngarla tribe. He said that his own people were skilled fishermen, able to swim up to a turtle, take hold of the shell at its neck, overturn the animal, and then wrestle with it in a swim back to shore.

Kariara identification of some marine creatures was not always positive. Recent generations largely have had to abandon the gathering of marine foods in favour of work with Europeans. But some details they remember seem important. They appreciate the value stingrays had, both for the early artists and for their own activities. These and other fish provided them with spines for spear tip armatures; the serrated tailspine is still used for various cutting purposes, while their fat is much sought after as food and for rubbing on their bodies as protection against the sun and for decorative purposes. Kundjing drew particular attention to the picturing of these internal fat bodies as if they were externally visible, and to other examples engraved separately on a large scale, as in Fig. 76. The Port Hedland artists, when drawing fish and other marine animals, seemed habitually to show both eyes. An exception is in the unidentified fish seen in Fig. 81 where an unusual side view of the creature is given.

Figure 82 appears to represent a pinniped mammal and it is possible that the engraving records the existence of fur seals in the Hedland area during the times of the Pre-Kariara people. Figure 83 was considered by a Ngarla man to be a small and benign shark, good for eating, and he named it as ['maritja'wariŋ]. The same edible quality was ascribed to the saw-shark shown in Fig. 84. Incidentally, in the Fitzroy River, further north, such saw-sharks during flood seasons may go far inland for nearly 200 km, and may become permanent inhabitants of the large freshwater lagoons often present there. One such saw-shark was shot by Joseph Birdsell while on a hunting trip during our stay at Liveringa Station. Figures 85 and 86 possibly



FIGURES 84–92. Fish and marine mammals. 84, saw-shark, *irawari*, length 160 cm; 85–86, fish, Australian salmon-like, lengths of both 106 cm; 87, fish, gurnard-like, 76 cm; 88, not identified, length 160 cm; 89, unidentified, perhaps shark, length 100 cm; 90, Dolphin-like, length 335 cm; 91, doubtful, 'saltwater fish' of Jabili, body length 86 cm; 92, whale, *kadarabaga* of Kundjing, the *purukulana* of the Ngarla, length 2.5 m, kangaroo tracks in place for eyes are a subsequent addition.

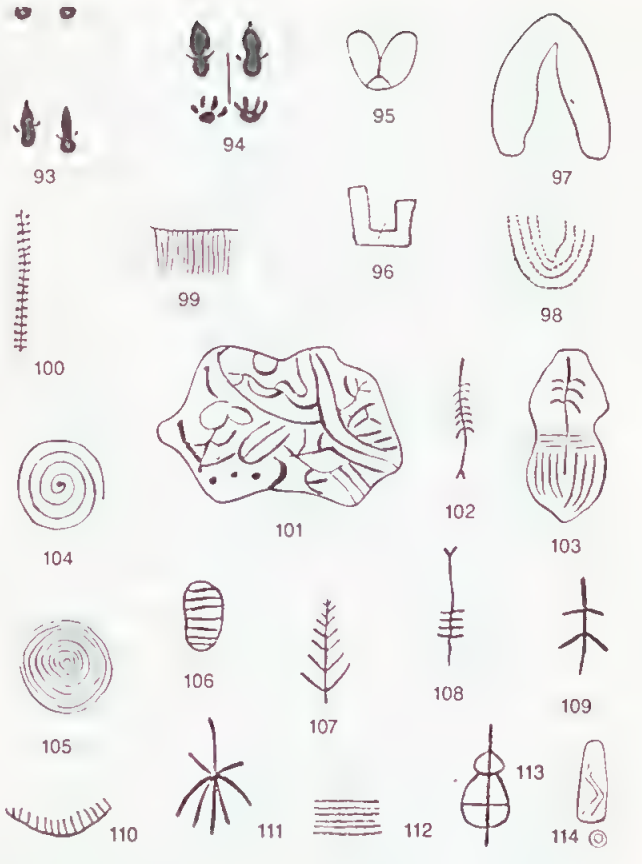
represent a salmon-like fish of large size, and Fig. 87, unidentified, seems to have long pectoral fins much like a gurnard. Descriptions of dolphins, for which they could not at the time recall the Kariara name, applied to Fig. 90, while Fig. 91 was of a fish, perhaps a hexanthid shark. Figure 92 represents the whale engraving which Kundjing spoke about when we had our first conversation with him on the Port Hedland carvings. He called it *kadarabaga* in his southern Kariara dialect, and other men afterwards used ['kararabuka], the Port Hedland version of the same name. It will be noticed that in the whale engraving a pair of kangaroo foot tracks were cut over the area where eyes originally might have been present. Younger men expressed regrets that feasts of stranded whale had not taken place during their time. Evidently older people had fond memories of such feasts.

Kangaroo tracks frequently were the subjects of the old artists, often, as in Fig. 93, emphasizing the deep impressions of the hind legs made in places favourable for registering such prints. Figure 94 depicts another set of prints in which the forepaws suggest a moment of slow feeding (at such a time the animal would be a better target). In the latter example there was a human footprint carving and also a long spear-like groove 2.8 m long. The juxtaposition of these three elements may suggest that they had been placed there to record a hunting episode but, as emphasized elsewhere in this report, such combinations implying action are rare as compared with isolated static images.

Entirely different are the impressions on the ground representing human beings, as in Figs 95 and 96. They both register the imprint made by a squatting or seated person. The first represents a man, and the somewhat more formal one happens to indicate a woman, as registered by the digging stick which is shown in her lap. Figure 98 was interpreted as a seated man with bird down or feather ornamentation fastened to his body with blood, as might be the case when he was decorated for a dancing display. There was dispute as to Fig. 97 which was carved much too large to be a normal-sized man's sitting imprint.

For lack of opportunities some of the smaller drawings were not identified, but more than one informant suggested that Fig. 99 represented a fur string genital cover, either of the fur of the kangaroo rat or of the opossum. This type of pubic cover was used by Kariara persons of both sexes, especially when flies were more irritating than usual.

The original of Fig. 100 was thought by Kundjing to represent a necklace made of pieces of shell stuck onto a hair string base using resin. Later, when working with Jammi, a Kurama man from the Hamersley Ranges, far inland, we learned that during secret ceremonies initiated men there often



FIGURES 93–114. Impressions, decorative designs, and symbols. 93–94, kangaroo, *waringura*, foot tracks; 95, buttock imprint of man (small carving, width only 23 cm); 96, woman with digging stick (small carving, width only 13 cm); 97, not recognised, 90 cm long; 98, buttock print of feather-decorated man, width 20 cm; 99, fur string modesty shield, width 23 cm; 100, necklet, length 38 cm; 101, much debated shield or skin design, length 84 cm; 102–103, body designs; 104–105, spiral and circular designs representing totemic homes or places, diameter 25 cm; 106, not recognised; 107, whitewood ornament, length 23 cm; 108, body design, length 30 cm; 109, lizard, length 25 cm; 110–113, not recognised; 114, shield with *maini* marks, length 95 cm and circular totemic design *ngorinj mimburu* newly incised by Jabili (white name Dick) of Njangamarda tribe, on 19 May 1953.

wore necklets made of pieces of pearl shell fastened to a fur string band, or to a hair string choker, by being affixed with porcupine grass resin. The Kurama term for the necklace was ['tjitjarliri] and the pearl shell came to them in trade from the Ngaluma tribespeople of the Roebourne area by way of the Indjibandi. The Kurama, who in earlier days had no knowledge of the sea, gave mulga wood spears in exchange for the shell ornaments. Good quality mulga (*Acacia aneura*) country occurred in their tribal areas and continued south for a great distance. Their mulga shrubs, called ['kuritjarda], supplied spear shafts which were better than those available to the Indjibandi. Thus there always was a demand for Kurama spears.

Figure 101 was much disputed. To some it was a shield. Its dimensions were much the same as those of their own shields, but no one made them with ['mani] marks like the ones decorating this one. Later, when we were in Halls Creek, an old man named Ngepal of the Whadjuk tribe from near Perth, on being shown my drawing, had his own thoughts about it. He had been a lifelong resident in the northwest of Australia, following extradition for some long-forgotten youthful offence against white men. He claimed that marks on the strange shield-like carving were similar to the designs on the inner side of decorated skin cloaks such as those worn by his people when he was a boy in his own country. Virtually forgotten, Ngepal in 1953 probably was the last living person of full descent from the Whadjuk tribe of Perth. He provided me with a vocabulary and other details for study (Tindale 1974: 260).

In the engravings at Port Hedland the early artists frequently used concentric circles and spiral designs similar to those shown in Figs 104 and 105. To the Kariara they were ceremonial patterns, known as ['kuri], painted on the ground and on objects for display in various ways during dances in which both sexes could take part. Visiting members of the adjoining inland tribes used similar designs, which were sometimes quite elaborate, but only for secret decorations displayed during initiation ceremonies from which women were excluded. Such visiting tribesmen did not appreciate the open display of the markings on the rocks at Port Hedland, and they feared that their women might see them.

Figure 107 was thought to be an engraving of a ['maŋgar'maŋgar], or scraped stick ornament, as made and used by the Kariara when decorating their hair or bodies to take part in displays of dancing before their women and children. The Kariara had no secret ceremonies. These scraped white wood sticks 'looked like flowers'. They were made by scraping masses of shavings from sticks of the *Atalaya* shrub which has a very white wood. Masses of the soft curled shavings became part of wig-like hair dressings. Very often the shavings were left attached to a tapered base stick as they dried they curled up, giving the look of a decorated hairpin. In the same manner, the shavings still attached to sticks could become other forms of decorated appurtenances. A Ngarla man, who said his people also used these *manggar*, supplied a variety of names for them according to their particular uses. A fully dressed Ngarla dancer might wear up to four short decorated pins called ['tjura] in his hair with a longer one ['katjiri] thrust laterally through a rolled or gathered bundle of hair on the back of his head. Still other such ornaments, called ['iljibiri], would be worn around his arms just above the elbow, with one or more, known as ['wambi], thrust under a belt around his waist. In dancing he might flourish several longer sticks with gatherings of shavings at intervals along their length. These were called ['pilu]. Depending on the subject of his performance, he might carry a boomerang or a spear in one hand and a ['karubinj], or shield, in the other.

Early in our stay I had been copying engravings near the hospital when I had a visitor, an old man named Jabili from Wallal, a Njangamarda of the group living near the sea. He sat and watched for a while and then volunteered some identifications, claiming that he could 'read them all'. He thought he was still in Ngarla country and said that people in his own country also made such marks. He recognised both emu and ibis tracks. Nearby, as it happened, there was a design (shown herein as Fig. 108). This design and similar marks he claimed were placed on the bodies of dancers, and he began to demonstrate, rubbing some limestone on the rock, wetting it with saliva, and painting it on his chest with his index finger. Pointing at a drawing I had already on my card, he identified Fig. 103 as a man's body with the same kind of design he had placed on his own chest. It seemed that these might be considered as personal identification marks. We talked of shields and he said that his people's shields always had ['maini] or ['mani] marks on them, and with a piece of stone he lightly cut parallel zigzag lines on the rock. I made a sketch of this modern addition to the engravings, as Fig. 114. We had been discussing other carvings when I noticed that also he had cut a circle within circle design. Perhaps it was an absent-minded cutting of a ceremonial mark. He called it ['ŋorinj mimburu] for which I was unable to get a translation. He was returning to Wallal and unfortunately I was not able to see him again.

Illustrative Drawings by My Informants

In my discussions with the Aborigines who helped me to understand their ideas about the Port Hedland engravings we covered other aspects of their life not enlarged upon on in this brief study. More than one of them who had no actual model or artifacts to show, chose to use drawings to illustrate their thoughts about the subjects we had been discussing. A few of these drawings are included in this paper as Figs 115–131. Others have been used as part of the background data for this paper. They could warrant a further paper on various ways of life along the coastal country of Western Australia, together with results of enquiries into kinship, language, and story details gleaned as accessory parts of the fieldwork plan on our 1953 expedition.

FIGURES 115–122. Drawings of Kariara spears by Kundjing in illustration of his discussion about Port Hedland engravings. 115–116, called *karuparta*; 117, *karta*; 118, *walakari*; 119, *tjaran*; 120, *winda*; 121, *wadakutara*; 122, *wadjir.*

Figures 115–122 illustrate the thoughts of Kundjing in support of his remarks about the similarities between the Pre-Kariara spears and those of the Kariara tribe. They are named:

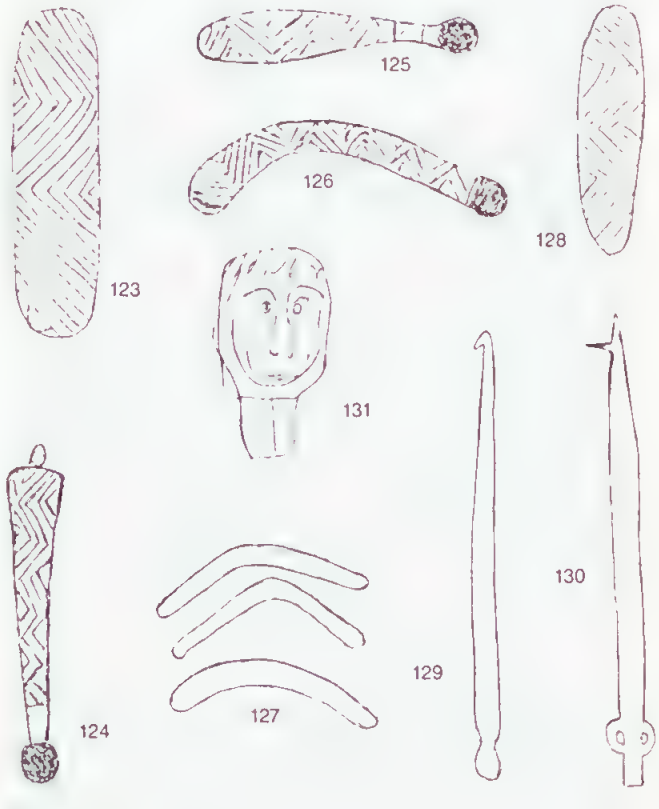
Fig. 115 'karuparta	Fig. 119 'tjaran
Fig. 116 'karuparta	Fig. 120 'winda
Fig. 117 'karta	Fig. 121 'wadakutara
Fig. 118 'walakari	Fig. 122 'wadjir

He pictures the harpoon-like spear in Fig. 122 as having a wooden barb integral with the shaft. At first he could not recall its name, *wadjir.* It had a knob at the butt end to help in securing a human hair rope-line, the other end of which was tied about the fisherman's waist. In his drawings the butts of the other weapons were marked, somewhat out of proportion, to indicate that the butts had holes into which spearthrower pegs would fit.

Figures 123–127 were drawn also by Kundjing to illustrate other artifacts of the Kariara, including their *jata* shield, their *walbara* spearthrower, used with the grip between thumb and forefinger (Method A), their club called ['pilbin], used in close fighting, and in Fig. 126, the *waruwaru* boomerang for fish killing, which he stressed was cut from the heaviest available hardwood. A group of three boomerangs (Fig. 127) shows the several shapes preferred for their returning ones, the *wakundi.*

Another Aboriginal illustrator, Nguno, an initiated man of the Pandjima tribe of the Hamersley Ranges, provided two drawings for this paper. His people were leaders in the spreading of the secret rites of initiation for their young men, and according to their traditions, they lived so far to the east in olden days that they had no knowledge of the existence of the sea. Figure 131 gives his impression of a newly initiated ['malbu] or Pandjima man. Figure 128 pictures their shield, called ['jandijiri], which shows a very close resemblance to the engraved ones on the rocks at Port Hedland.

Mekata, a member of the Njangamarda Kundal tribe, about 200 km east of the Kariara country, took a leading part in some of our discussions and provided two drawings illustrating long spearthrowers, known as [ŋabalinj], shown here in Figs 129–130. These are used in the throwing of



FIGURES 123–131. Further illustrations by Aborigines. 123–127, drawn by Kundjing, of Kariara objects; 123, shield, *jata*; 124, spearthrower, *walbara*; 125, club, *pilbin* for close fighting; 126, boomerang for fishing, *waruwaru*, also used while standing up 'arm in arm'; 127, outlines of three *wakundi* returning boomerangs; 128, shield, *jandijiri* of Pandjima tribe of Hamersley Ranges by man Ngoera; 129–30, long spearthrowers *ngabalinj* traded to Njangamarda tribe through Mangala from Walmadjari people whom they call Tjiwaling; they are used with the index and middle finger grip; 131, concept by Ngoera of a newly initiated Pandjima *malbu* or man.

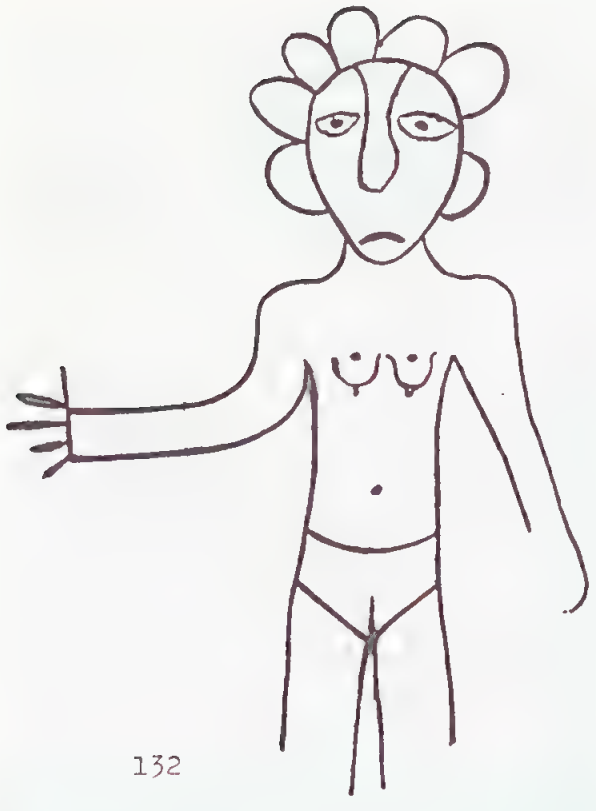


FIGURE 132. Strange figure, not recognised by the present-day Kariara — possibly of foreign origin.

spears while employing the grip (my Method B) in which the spearthrower is held between the fore- and middle fingers. These are obtained by trade from the Mangala tribespeople who in turn were said to get them from the Tjiwaling people still further east. Later at Christmas Creek Station we learned that Tjiwaling was a western name for the Walmadjari who were in contact with the Kitja and the Djaru of the Hall Creek area. Thus there were indications of a trade route for *ngabalinj* of about 900 km. This seems to have provided a route by which cultural novelties came to the Kariara.

Conclusions

There are few direct clues as to the age of the Port Hedland rock carvings. Present-day Kariara Aborigines accept them as being made by people similar to themselves and consider that they understand their meanings and the motives influencing the earlier artists who made them. Kundjing, one of the oldest living Kariara men, recalled a tradition of people like themselves coming from the south and making some of the engravings.

Geologically the situation of the freshly planed off rock surfaces on which the engravings are concentrated, standing as they do only three to four metres above the present highest tide marks of the bay, yields a limiting date falling near the end of the latest Peronian eustatic higher sea level at around 3 500 to 3 700 BP. The relative absence of signs of aerial erosion tends also to place a further limit on the age of the carvings. The Kariara recognise the principal types of their own weapons as being present among the engravings, and they have ready explanations for the meanings of the designs. The presence of engravings of hafted edge-ground stone axes is important. Mulvaney (1975: 194) concluded that there may have been some reason for a gap between the older Pleistocene stone axes of the tropical parts of Australia and the far younger basaltic rock types which appear so commonly in much of Australia from Mid-Recent time on. In parts of Australia where stingless honey bees occur, the present-day axes are constantly being employed in the chopping out of their nests in the hollows of trees. In the Kimberleys of Western Australia both earlier and later axe types have been found. Mulvaney (1975: 147) shows a photograph of a pecked, grooved, older type axe from Stonewall Creek, and another well-worked one was found by us (Tindale: 1981: 1772, Fig. 5, right) at Moolabulla, near Halls Creek, with similar groove on a quartzite core. After some use the Moolabulla one had been adapted by knapping to form a chopping tool of the type considered to be characteristic of Kartan times in the earlier half of the Wisconsinan or Last Ice Age.

In earlier paragraphs references were made to the *tjimari* knife as present among the engravings at the Port. Figure 133 shows a living culture Njangamarda example obtained by J. B. Birdsell and P. J. Epling during an early stage of the fieldwork at Marble Bar. It may be considered very characteristic of ones widely known today from the western part of Australia. In some tribes there *tjimari* are still in general use and in others they are kept, in secret, away from women, and used only in their initiation rites for young men. The discoidal form of such flake knives becomes well developed in use and generally as the result of one or more retrimmings. The knapped parts extend around about one-half of the perimeter. After retrimming, some of them are developed with a partly concave margin when needed for trimming such objects as shafts of spears and those of other weapons such as clubs. The back of the knife, covered by the resin handle from the very conception of the flake as a tool is often entirely untrimmed and may be untidily irregular, which may be useful in strengthening the bond between handle and knife. In archaeological specimens this contrast of untrimmed and worked parts leads rather readily to their identification as *tjimari*, as does also the frequent presence of roller-pressure fine-trimming preserved on the cutting edge of the knife (Tindale 1965).

In eastern Australia, particularly in the riverine corridor lying west of the Great Dividing Range,

FIGURE 133. Resin-hafted unifacially worked flake knife, *tjimari*, of crypto-crystalline gray chert from Kardama Hill, east of Warrawagine, received from Mudjing of the Njangamarda tribe, May 1953, diameter 7.7 cm.

the use of *tjimari*-like tools was replaced in the Mid-Recent by other tools, ones of the so-called Microlithic Culture Phase which appeared suddenly, full-fledged, and spread widely just after the Mid-Recent, rather quickly in the east and more slowly across the desert interior to the west. Hale & Tindale (1930) found the original evidence for the change-over in mineralised beds at Tartanga, on the Lower Murray River, an Aboriginally-named midstream island bank. Hale & Tindale selected the name to represent a cultural phase older and geologically separate from a great depth of Aboriginal occupational debris, recording three named phases in an adjoining rock shelter, then known as Devon Downs, but now correctly recognised by its Aboriginal name, Ngautngaut.

At Tartanga the change-over in stone tools is geologically recorded from older and larger flake ones to the newer microliths, which appear only above a water-laid sterile blue-black clay horizon (their F) of relatively great thickness, now known to be the silt layer deposited during the many centuries of the Peronian high sea levels between 6 000 and 3 500 BP. The few tools found in the post-Peronian beds above it matched those found in the three named phases found in the six metre fill of occupational deposit in Ngautngaut rock-shelter. Thus it happened to be that it was the latest phase of the Tartangan culture phase that was named. Its tools were shown in detail (Hale and Tindale 1930: 149, Fig. 4) and from the geological section (their Fig. 4), it is clear that the separation from the microlithic tools of the Upper Beds G to I is real and complete. From the beginning it was recognised that the Tartangan type site tools were in an area where stone for tools was not readily available and other richer sites were soon on record in the South East of South Australia and elsewhere. After interest in Australian archaeology developed elsewhere it unfortunately happened that misinterpretation of the Tartangan data as published, led to the ignoring of the clear-cut geological evidence. This seems in part to have been due to an older view that Australian stone implements could not be typed and that all kinds were present only by chance. There was little appreciation of the long time-span of the occupation of Australia. Today it is clear that the Tartangan stone tools can be recognised as dominating the Australian culture scene from as early as the Pleistocene occupational horizons of the 30 000 BP era at Lake Mungo, in New South Wales down to around 6 000 BP in eastern Australia, with survivals of some of its tools in a slowly progressing transitional phase, spreading towards the west and leading to the dominance of the Microlith tool type still in progress in the far west. Thus the presence of the *tjimari* as the key tool of the long-lasting Tartangan phase in Australia and Tasmania and surviving in part even today in the northwest, is important. Very isolated tribes, such as the Nakako, who first came into contact with Europeans only in the 1960s, live more than 900 km south-east of the north-west coast. They also had the same Tartangan-type knife.

Mulvaney, unfortunately, in disregard of the great priority in our nomenclature, has tended to avoid recognising the reality of a Tartangan culture phase and its range of key tools, tending to use instead a vague term such as 'Tasmanoid', to describe his own finds at Kenniff Cave and elsewhere. An anthropologist with geological training should re-

examine the site on Tartanga Island. Having had training in Pleistocene geology myself, it is my opinion that the geological realities of the original Tartangan site should be studied again, when the original work there will be cleared of the errors in interpretation which have occurred. The priority and status of the term Tartangan also will be verified.

Acknowledgments

This author acknowledges the support in his researches by the Members of the Board of the South Australian Museum and its Directors over the more than sixty-five years of his association with the organization.

Permission to do fieldwork was granted by the then Department of Native Welfare of Western Australia to members of the University of California at Los Angeles and the University of Adelaide Anthropological Expedition of 1952 to 1954. Professor Joseph B. Birdsell and this writer (accompanied for several months by the late P. J. Epling) made anthropometric records and conducted anthropological enquiries among the Aborigines of Western Australia.

Members of the Expedition had the full co-operation at all stages of the Native Welfare officers, and for the particular work at Port Hedland District; Officer Harvey Tilbrook was most helpful in stimulating the interest of the Aborigines in the work of the Expedition. In the course of the eleven months spent in Western Australia more than a thousand Aborigines helped in the studies.

Joseph B. Birdsell and I have been associated in such fieldwork since 1938 and I appreciate continuing periodic discussions with him. My wife Muriel Nevin Tindale has been helpful in the ordering of this paper, and Mrs Eloise Hardman has had the onerous task of deciphering my almost impossible writing. I am indebted to Peter Sutton and Christopher Anderson who saw this paper through the press while I was absent in California. There may be some errors of which I am unaware, and some omissions of data still in my extensive field journals; for these I must be held responsible.

Endnotes

1. In this paper when individual Aboriginal words and names are mentioned for the first time they are transcribed in International Phonetics as set out in my book on Australian tribes (Tindale 1974: 2) and placed in square brackets. When used again they are given in close conventional form, with place names in particular following the mandates of the Geographic II system of spelling.

2. ['mitji] is their normal word for blood, not *toraa*.

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OBITUARY

IFOR M. THOMAS

1 April 1931 – 14 August 1985

Ifor Morris Thomas was born on 8 July 1909 at Aberdare, south Wales and died at Adelaide on 14 August 1985. He was the fourth and youngest son of Thomas and Jane Thomas (née Watkins). His father was Headmaster at Aberdare Grammar School. Ifor received his primary and secondary education locally and in 1928 went on to study science at the University of Wales at Cardiff. He graduated B.Sc. in 1931 and B.Sc. (with Honours) in 1932. In 1933 he undertook postgraduate research on crustaceans under Professor Tattersal and at the end of the year gained the degree of M.Sc. After graduation he acted as Demonstrator in Zoology, gave a series of lectures on Biology to the Workers' Educational Association of Wales and, much to his liking, spent some time on board a trawler in the North Atlantic as a collector of marine specimens. His Atlantic experience undoubtedly influenced the future course of his life, serving to stimulate a keen and life-long interest not only in marine biology but also in boats, ships and the lore associated with them.

He came to Australia in January 1939 to take up a lecturing post in the Department of Zoology at the University of Sydney, at that time under the direction of Professor W. J. Dakin. His arrival happened to coincide with a huge bushfire which endangered many districts along the coast of New South Wales and covered Sydney with a pall of smoke and ashes. He used to relate how dismaying were his first impressions of Australia. He soon found himself, however, fully occupied in his new post, where his duties included teaching and organising classes in physiology, lecturing on invertebrates and assisting in the running of a small collecting vessel called the 'Thistle'. When World War II broke out in 1939, Ifor and a colleague, Allan Colefax, became involved in devising ways of camouflaging objects at sea and on land. They specialised on the construction and use of different kinds of netting for use in concealing things on the ground.

In 1947 Ifor joined the staff of the Department of Zoology of the University of Adelaide as Lecturer and became Senior Lecturer in 1950. He remained in Adelaide for the rest of his life and occupied a senior post in the Department until he retired at the end of 1974. In 1973 and 1974 he acted as Head of the Department. In 1947 the lecturing staff of the Department consisted only of him and Professor T. H. Johnston. During an association of almost 30 years with the University of Adelaide he lectured to students at all levels and on almost all aspects of zoology. Most of his early teaching was to second and third year classes but as the number of post-graduate students increased and the number of the staff grew, more of his attention was given to those reading for Honours, Masters and Ph.D. degrees. His chief interest was marine zoology. His third year 'unit' course in marine zoology was always a popular one; students found the lectures and practical work interesting and

stimulating. For many years he used to take a party of his students for a couple of weeks each year to the CSIRO Marine Laboratory at Cronulla, New South Wales, where they made good use of facilities that were not available in Adelaide. The trips were a great success and much liked by the students. Some of them, although now old and sere, still talk about them when they meet. Most of his advanced and post-graduate students took for their research topic some aspect of the biology of a common, South Australian marine or freshwater animal. Some of the animals studied were the freshwater mussel, rock lobster (crayfish), whiting, garfish, 'Coorong' mullet and black bream. Consequently his influence in the fields of freshwater and marine research in South Australia was very considerable. Many of his former students today occupy posts, some senior, in the State Fisheries Department, the State Water Laboratory, the South Australian Museum and Australian Universities. Without doubt most of them were encouraged to pursue their careers as marine zoologists or ichthyologists as a result of attending his classes.

His own research was concerned with: (1) the taxonomy and certain aspects of the physiology of enteropneusts (Hemichordata), and (2) the zoology of the intertidal zone. He published papers on both topics. His best paper was probably that on the accumulation of radioactive iodine in the endostylar region of the cephalochordate *Amphioxus*. By using autoradiographic techniques he showed that certain regions of the endostyle of *Amphioxus* were able to take up radioactive iodine to form a mucin-like substance that contained iodine. His results lent support to the idea that the endostyle of the lower chordates was the forerunner or homologue of the thyroid gland of cyclostomate fishes and so of early vertebrates. He wrote two papers on intertidal shore life. He enjoyed nothing more than working along the coast, especially during the summer. On such occasions his 'outfit' was special — a very large, wide-brimmed straw hat (held in position by an elastic chin-strap), slightly 'oversized' shorts, a khaki shirt, long stockings (he sunburnt easily) and white sand shoes. To a collecting bag, held in place by a strap around his shoulder, were fastened by plastic tapes a pair of scissors, a pair of forceps, a hand lens, a large pocket knife and a pencil. For good measure his spectacles were sometimes attached to the lapel of his shirt. So engrossed was he in his work, however, that he was never aware of the slightly puzzled looks that he sometimes drew from quizzical bystanders.

After retiring from the University at the end of 1974, he continued an active, scientific life as an Honorary Associate attached to the Marine Invertebrates Section of the South Australian Museum. His work was now directed mainly along two lines. Firstly, he acted as advisor to the Electricity Trust of South Australia on the thermal pollution of marine environments caused by the building of power stations in the State. Secondly, he acted as co-editor of one of the recent publications of the Handbooks of the Flora and Fauna of South Australia, namely 'Marine Invertebrates of Southern Australia, Part I'. The book is a very useful one because it helps to fill some of the gaps in the knowledge of the invertebrates of the State. Part II was almost completed when he died.

During his life in Adelaide he took an active interest in a number of societies. He served as Secretary, Librarian, Councillor and President of the Royal Society of South Australia and acted as Assistant Editor of its *Transactions* for a number of years; in 1977 he was made an Honorary Fellow, a rare honour. He was a member of the Royal Zoological Society of South Australia, the Australian Marine Sciences Association, the Nature Conservation Society, and the National Trust of South Australia. He was also a member of the Institute of Biology.

To those who knew him well he was a good friend and a valued colleague. He could be courageous, too. Not many people know that about four years ago, by challenging an apparently armed man, he foiled the robbery of a suburban bank.

Ifor was well-liked by both his students and those with whom he worked, and was always approachable, reasonable and helpful. His contribution to marine zoology in South Australia was a most valuable one.

He is survived by his wife (née Patricia Mawson) and three sons.

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OBITUARY

BRIAN DAILY

1 April 1931 – 6 March 1986

Dr Brian Daily died in his home in Adelaide on 6 March 1986, after a courageous battle with cancer, during which he continued to work right up until his death. For five years in the 1950s he had worked in the South Australian Museum.

Brian was born in Adelaide on 1 April 1931. Following schooling at the Marist Brothers School, Norwood, and Sacred Heart College, Somerton Park, Brian attended the University of Adelaide where he completed his B.Sc.(Hons.) in 1952 with a thesis on the Tertiary sequence of the Noarlunga Basin. He continued on to his Ph.D. on the Cambrian stratigraphy and palaeontology of South Australia. This work, for which he was awarded the 1956 Tate Medal of the University of Adelaide, has been the basis of most subsequent studies on the Cambrian of South Australia. The faunal assemblages that Brian established have been used as a reference succession for Australian Lower Cambrian sequences.

While still a student in 1954, he joined the late C. P. Mountford's National Geographic Society expedition to Arnhem Land, and made the first comprehensive collections of fossils from Bathurst and Melville Islands. Mostly ammonites, these are still being studied.

Brian completed his Ph.D. late in 1955, and joined the South Australian Museum in January 1956, as Assistant Curator of Fossils. Subsequently he became Curator of Fossils and Minerals, demonstrating his versatility and gaining valuable experience for his later career. Brian was indefatigable in the field, as many of his students can attest. While at the Museum, he collected widely throughout the State: Tertiary plant fossils on the Arcoona plateau in 1956 and again in 1960; Pleistocene mammals at Hookina Creek in 1956; Cambrian trilobites from Kangaroo Island in 1957, and Precambrian fossils at Ediacara in 1957, 1958 and 1959. He also collected from the Cambrian and Triassic

of the Flinders Ranges in 1959, and from the Cambrian and Ordovician of central Australia in 1959 and 1960.

In 1957, Brian joined Professor R. A. Stirton of the University of California, Berkeley, for a three month expedition into the Lake Eyre region in search of Tertiary marsupials at Lake Palankarinna and adjoining areas, discovering the richly fossiliferous deposit of Pliocene Mampuwordu Sands in the Lawson-Daily quarry, and making an important contribution to the understanding of the geology of the area. His interest in the region continued through the years, and he and his students used the southern shores of Lake Eyre North for fieldwork.

During these years, he began to take on a consultancy role, examining bore material for the South Australian Mines Department and petroleum explorers. Thus he studied the fossils of the Minlaton and Stansbury Stratigraphic Bores on Yorke Peninsula, and later, the Gidgealpa No. 1 Well.

With several fellow students, he had been a founding member of the Cave Exploration Group of South Australia in 1955, and was influential in having that society closely affiliated with the South Australian Museum so that all specimens encountered, both fossil and living, became part of the State collections. Thus he was involved in a number of excavations in Naracoorte caves in 1957 and 1959, mainly for the (then) puzzling *Thylacoleo* or marsupial 'lion'. This interest in vertebrate fossils was maintained despite his first love — the Cambrian — and communicated itself subsequently to a number of his students, including one of us (NSP).

Brian resigned from the South Australian Museum in January 1961, and was subsequently made an Honorary Associate of the Palaeontology Section. He was appointed a Lecturer in the Department of Geology and Mineralogy, University of Adelaide, in 1961; was promoted to Senior Lecturer in 1964 and to Reader in 1974, a position he held until his death. Brian was an enthusiastic and dedicated teacher, particularly of field work. He was an excellent field observer with a wide general geological knowledge which he passed on to his students. During his time at Adelaide University, Brian supervised more Honours Degree projects than any other person in the department and also supervised a number of successful M.Sc. and Ph.D. projects, mainly on the Adelaidean and Cambrian geology and biostratigraphy of the Flinders Ranges.

Brian's main research activities were on the Precambrian and Cambrian stratigraphy and sedimentology of South Australia. He made substantial contributions to the study and understanding of the Precambrian/Cambrian boundary, both in Australia and overseas. This work included visiting important Precambrian-Cambrian boundary sections in North America, Argentina, China, Morocco, Europe and Siberia. He was a valuable member of I.G.C.P. project 7, 'South-West Pacific Basement Correlations', the results of which were published in G.S.A. Special Publication No. 9. In elucidating the stratigraphy and structure of the Kanmantoo Group, Brian, in association with Dr A. R. Milnes, made a major contribution to the understanding of the geology of Fleurieu Peninsula and Kangaroo Island. Unfortunately much of Brian's detailed and pioneering work on the Adelaidean and Cambrian sequences of the Flinders Ranges was unpublished at the time of his death.

In addition to his professional duties, Brian gave much voluntary service both to geology and science in general. In the period 1957-67 he was successively programme secretary, council member, vice-president and president of the Royal Society of South Australia. He was chairman of the S.A. Division of ANZAAS in 1981-1983 and was the ANZAAS correspondent for some years. His interest in geological education is shown by his acting as chairman of the S.A. Public Examination Board Geology subject committee and also a chief examiner of matriculation geology in South Australia over a number of years. Brian was a member of the S.A. Divisional Committee of the Geological Society of Australia in 1965-66, vice-chairman in 1967-68 and chairman in 1968-69 and was a proxy member of the federal executive of the G.S.A. in 1980-81. He served on both the S.A. Stratigraphic Nomenclature and Geological Monuments Subcommittees.

Both as a friend and a colleague Brian will be sorely missed. Deepest sympathies are extended to his family.

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INLAND, COAST AND ISLANDS: TRADITIONAL ABORIGINAL SOCIETY AND MATERIAL CULTURE IN A REGION OF THE SOUTHERN GULF OF CARPENTARIA

D. S. TRIGGER

1-FEB 1988

TRIGGER, D. S. 1987. Inland, coast and islands: traditional Aboriginal society and material culture in a region of the southern Gulf of Carpentaria. *Rec. S. Aust. Mus.* 21(2): 69–84.

This paper compares aspects of traditional Australian Aboriginal societies in inland, coastal and island settings, in a region of the southern Gulf of Carpentaria. It focuses on similarities and differences in material culture, after summarising comparative data on language, emic environmental classification, kinship and social organization, and genetics. As 'saltwater people' occupying what was regarded as 'saltwater country', coastal mainlanders were part of the island cultural bloc in significant respects, while being in other respects incorporated within a large cultural bloc which extended inland to the west and southwest. The paper proposes that the coastal mainlanders' relationship with the North Wellesley Islanders in particular, reinforced the maintenance of cultural differences between coast and inland society on the mainland. Despite arguments for the relative isolation of the South Wellesley Islanders, the paper describes a complex situation of overlapping cultural forms throughout the region, with no area emerging as completely distinctive.

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This paper presents comparative ethnographic data in a reconstruction of aspects of cultural diversity among Australian Aboriginal societies in an area of the southern Gulf of Carpentaria (Fig. 1). It is concerned particularly with the situation of coastal mainland dwellers located adjacent to two major off-shore island populations, and apparently subject to influences from diverse cultural traditions. These are traditions which will be glossed as those of 'inland society' on the one hand and 'islands society' on the other hand, although both labels themselves encompass a degree of cultural diversity.

The paper investigates the ways in which a mainland coastal group's relations with off-shore island societies may have influenced the former's relations with other mainland societies (particularly inland ones). It will be argued that while the coastal mainland society can be seen in some ways to be included within a broad cultural bloc extending inland to the west and south-west, in other respects it is clearly on the periphery of that bloc. The paper proposes that the influence of ongoing relations with North Wellesley Islands societies can be seen as having kept coastal mainland society on the periphery of the cultural bloc extending inland to the west and south-west. Hence, rather than focusing directly on the degree of isolation of the islands society, my approach is to ask whether major off-shore islands society exercises important influences over immediately adjacent mainlanders, thereby reinforcing tendencies towards cultural differences between the latter and those further inland.

Cultural differences between coast and inland in the Gulf of Carpentaria context have been noted in previous literature. Spencer & Gillen (1904: 634) mention the 'very considerable uniformity' in material culture in inland areas on the southwest side of the Gulf, 'until we come to the true coastal tribes, amongst whom we naturally meet with certain objects not present amongst the inland tribes'. For the south-eastern side of the Gulf, Tindale (1974: 121–122) notes the 'great contrasts between the life and economies of the inhabitants of the coastal mangrove and saline shore flats and the ways of the scrub covered upland dwellers'. Tindale also refers to the Aboriginal terms given in Curr (1886: 303) for the Leichhardt River mouth area, designating distinctive peoples of saltwater, freshwater and scrubland domains. Detailed material for the Cape Keerweer area on the east side of the Gulf, has been given in Chase & Sutton (1981). Those people living along the coastal strip are described as not having interacted closely with hinterlanders. Their territories are much smaller than those of inlanders with correspondingly higher population densities. Coastal people also possessed higher social segmentation, a richer ritual tradition and greater linguistic diversity (Chase & Sutton, 1981: 1835).

A considerable amount of literature is available for the study region dealt with in this paper. This is especially the case for work on the cultural traditions of the Wellesley Islands. Together with the results of my own research, this literature provides a sound basis for a broad comparative study of Aboriginal society in different environ-

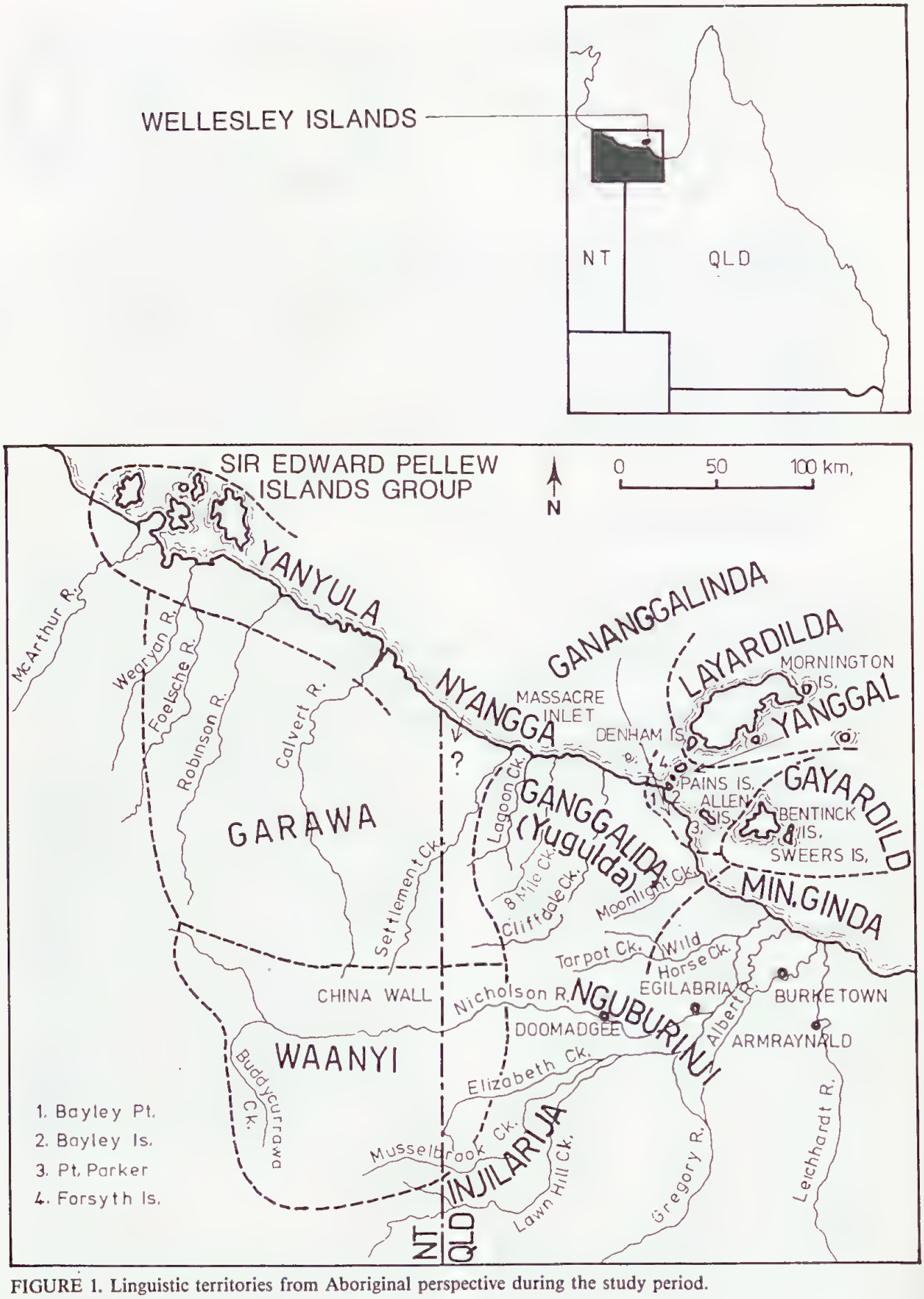

FIGURE 1. Linguistic territories from Aboriginal perspective during the study period.

ments. While other publications are planned, the present paper focuses mainly on a comparison of aspects of material culture across inland, coastal and island settings. Several museum collections of material culture from the region have proved a valuable resource in reconstructing aspects of traditional life. However, to establish the broader context for the data on material culture, I will first briefly discuss several more general issues: (1) the linguistic setting; (2) emic environmental classifications; (3) kinship and social organisation; and (4) genetic similarities and differences through the region.

The Linguistic Setting

This paper primarily concerns four definable areas within the range of language groups shown in Fig. 1: Garawa and Waanyi in the inland area to the west and south-west of the Wellesley Islands; Ganggalida[1] (and Gananggalinda) on the coast adjacent to the islands; Layardilda[2] and Yanggaal on Mornington, Denham and Forsyth Islands (constituting the main islands of the North Wellesley group); Gayardild on Bentinck and Sweers Islands (constituting the main islands of the South Wellesley group). Several points concerning the linguistic territories of the region warrant brief comment.

Contemporary Aboriginal opinion makes it clear that 'Garawa people'[3] were not 'saltwater people'. Mapping of traditional Garawa estates which I have completed indicates the northern most of them to be no closer than 25 km from the coast (cf. Tindale's [1974: 228] figure of 65 km). Across most of the northern limit of Garawa territory, the coastal area is Yanyula country. However, it remains unclear which language group was predominant in the coastal area eastwards from the Calvert River to the west side of Massacre Inlet (the western boundary of coastal Ganggalida country). The language name 'Nyangga' has been applied to this area in the literature, and I have discussed elsewhere (Trigger 1985: 340–349) whether there was in fact such a distinctive group in dialectal, territorial or sociopolitical terms. The issue is raised here to note that in comparing aspects of the inland Garawa traditions with the coastal Ganggalida traditions, I am most likely not comparing territorially adjacent linguistic groups.

We should also note the question of territorial proximity between Waanyi and Ganggalida traditions. As far as I have been able to reconstruct them (Trigger 1982, Map II), traditional Waanyi estates extended eastwards at least 30 km into Queensland from the Northern Territory border. The most precise data concern an eastern-most Waanyi estate on the Nicholson River. This does not indicate close proximity between Waanyi and Ganggalida as it is doubtful whether Ganggalida speakers were predominant along the Nicholson River in Queensland; the minimal but most reliable information (a hand-written note on a word list by Roth [1900]) suggests that Nguburinji speakers were predominant in this area (cf. Keen 1983: 193).

Linguistic work indicates that Nguburinji was mutually intelligible with Ganggalida, and in fact that these two, together with Yanggaal (on Forsyth Island) and Gayardild (on Bentinck Island), were dialects of one language; Layardilda (on Mornington Island) was 'a different but closely related language' (Keen 1983: 192; and see Evans 1985: 3). Two further points are thus significant. Firstly, the nature of linguistic relations demonstrates the incorporation of two substantial linguistic territories on the mainland (Ganggalida on the coast and Nguburinji further inland) within the 'Tangkic sub-group' (Evans 1985) extending throughout the Wellesley Islands. I use the notion of 'incorporation' of the islands and a section of the mainland deliberately to emphasise the lack of linguistic isolation of the island societies; Tindale's discussion of 'the relative isolation' (1962a: 278; and see also 1977: 256–7) of the language of the Bentinck Islanders is clearly inadequate (cf. Evans 1985: 9).[4] Secondly, Ganggalida speakers quite likely extended inland from the coast for a considerable distance (possibly up to 100 km); however, in the comparative analysis presented in this paper it is aspects of *coastal* Ganggalida society which constitute the significant unit.

The final point in discussing linguistic aspects of the region concerns the area on Fig. 1 labelled 'Gananggalinda'. This term was known during my research by only a few senior Ganggalida people. It was applied to a group of people said to have 'belonged beach side' in the area between Bayley Point and Point Parker (i.e. the coastal mainland area *immediately* opposite both the North and South Wellesley Islands, and incorporating a distance along the coastline of approximately 20 km). These are people said to have routinely visited several small islands comparatively close to the mainland (namely Bayley and Pains Islands approximately 3 km and 4.5 km off Bayley Point respectively, and Allen Island approximately 5.5 km off Point Parker). One senior knowledgeable Ganggalida woman has defined Gananggalinda as a form of speech very similar to Ganggalida, but with a different accent. However, it is probable that the term was essentially applied to a group of people rather than to a dialect.[5]

In establishing the setting for the further comparisons in this paper, it is appropriate to recognise these Gananggalinda people as a mainland group which was regarded by fellow

coastal mainlanders (at least those to the west) as *particularly* closely oriented towards the immediately adjacent small islands to the north and east. Indeed, it is probable that these people spent substantial time on the close off-shore islands, in regular contact with Yanggaal speakers based on Forsyth Island. They also had occasional contact with Layardilda people from Mornington Island, and perhaps even sporadic contact with Bentinck Islanders who may have travelled across to Allen Island. The latter contact would have involved safely traversing a distance of approximately 13 km by watercraft, and Tindale (1962b: 298–301) gives accounts of two attempts (in 1940 and late 1946 or early 1947, prior to major intervention by Europeans) where lives were lost. In the second attempt, 14 out of 19 persons attempting the crossing were drowned, and there is little doubt that such trips would not have been undertaken without knowledge of the great danger. Yet, it is likely that the factors reportedly leading to the 1940s crossing attempts (particularly quarrels and fights), among others, would have, in earlier days, led to sporadic successful crossings by small numbers of people from Bentinck Island to Allen Island. Tindale (1962a: 273, 290–291) found oral traditions among the Gayardild which recounted occasional hostile encounters with mainland Aborigines on Allen Island. Evans (1985: 15–16) suggests that 'whatever contacts there were, that did not end in death or exile, must have been separated by decades of isolation'; he also mentions that nothing was obtained by the Bentinck Islanders via trade.

Having mentioned this distinctive 'beach side' mainland group, I will nevertheless subsume them within the category of coastal Ganggalida people throughout the paper. In fact, there is little remaining specific knowledge of these people, and among the reasons for this is an apparent revenge killing carried out on Bayley Island by Yanyula people from the northwest. Historical records (*The Queenslander* 10 April 1897: 774) indicate that this occurred in 1897, and according to Aboriginal oral tradition a large number of people were killed (see Trigger 1985: 140–141).

The Distinctiveness of the Mainland Coastal Area: the Aboriginal View

Various kinds of distinctive environments throughout the entire study region are distinguished in Aboriginal classification (Trigger 1985: 63). However, none are regarded as so significantly different as 'saltwater country'. Ganggalida terminology for the coastal area is shown in Table 1. As the English translations indicate, the environment consists of long sand ridges (supporting open woodland) typically parallel to the beach and dune areas. These raised ridges are separated by flat sandy stretches of ground varying considerably in width. In some areas, 'saltpans' or saline coastal flats separate the sand ridges, but the widest area of saltpan is usually between the most inland sand ridge and the beginning of sharply defined open sclerophyll woodland which extends inland to the south (Fig. 2).

From the Ganggalida perspective the sand ridges are termed 'islands' (*murndamurra*). The same term is used for the small islands immediately off-shore. In the Aboriginal view, the 'land' or 'mainland' (*wambalda*) thus begins at the inland limit of the saltpan, which also marks the inland limit of what is generally known as 'saltwater country'. Figure 3 shows this limit approximately, designating a coastal strip of 'saltwater country' extending southwards for varying distances between 3 km and 10 km from the beach. At times during the wet season, much of the saltpan areas are said to be covered with water (probably from tidal surges as well as from the flow of fresh water from the inland), leaving the 'island' sand ridges isolated with water on all sides.

In the Aboriginal view then, the coastal strip is regarded as environmentally distinctive and different from further inland, and in fact is

TABLE 1. Schematic representation of Ganggalida classification of environmental zones in the mainland coastal area.

<------ North					
malara 'sea'	*/mirlaja/mala/lilu* /go back/sea/north	*ngarnda* 'beach'	*dumuwa* ... 'sand ridge' 'sand ridge' ...	*gabara* 'saltpan'	*gin.gara* 'flat country'
	[inter-tidal zone]		... [multiple ridges] ...		[on other side of saltpan]
			area containing <----*murndamurra*----> 'islands'		
<---------- 'saltwater country' ---------->					'mainland' 'land' *wambalda*

FIGURE 2. The physical environment in the coastal mainland area (Ganggalida country). The long sand ridges parallel to the coast-line are evident from the lines of vegetation. The area of saltpan in the background separates the coastal strip containing 'islands' ('saltwater country') from the 'mainland', in the Aboriginal perspective. The saltpan and mangroves in the foreground occur only occasionally along this stretch of coastline. (Courtesy of Connah/Jones Aerial Archaeology, University of New England.)

conceived (in general terms at least) as containing areas equivalent to the close off-shore islands.[6] However, this narrow coastal strip should not be considered as socially isolated in any way. Figure 3 indicates quite precise boundaries for the coastal estates, to the east and west; the boundaries are hence the sea to the north, and creeks and salt-arms to the east and west. But the boundedness to the south (i.e. in an inland direction) is much less precisely defined. All estates except one in the area shown on Fig. 3 extend across the saltpan to the 'mainland' to include one or more fresh waterholes. In the case of the exceptional estate (F), it includes site F1 (Gunamula), a large fresh water lagoon near the mouth of Cliffdale Creek, which is said to contain surface water for a substantial part of the dry season. Seasonal movements across the saltpan to waterholes, occurred particularly during the middle and late stages of the dry season, not so much because of a lack of fresh water in 'saltwater country' (for this is said to have been always available by digging 'soaks'), but in order to obtain certain material resources apparently not at that time readily available on the 'islands' (e.g. water lilies, *Nymphoea* sp. and *Nymphoides* sp.). During parts of the dry season people are also said to have come to the coastal strip from a considerable distance inland; however, they apparently rarely remained there during the wet season because of their lack of tolerance of the increased number of mosquitoes then. The significant point here is that apart from the recognition of the environmental distinctiveness of 'saltwater country', people are said

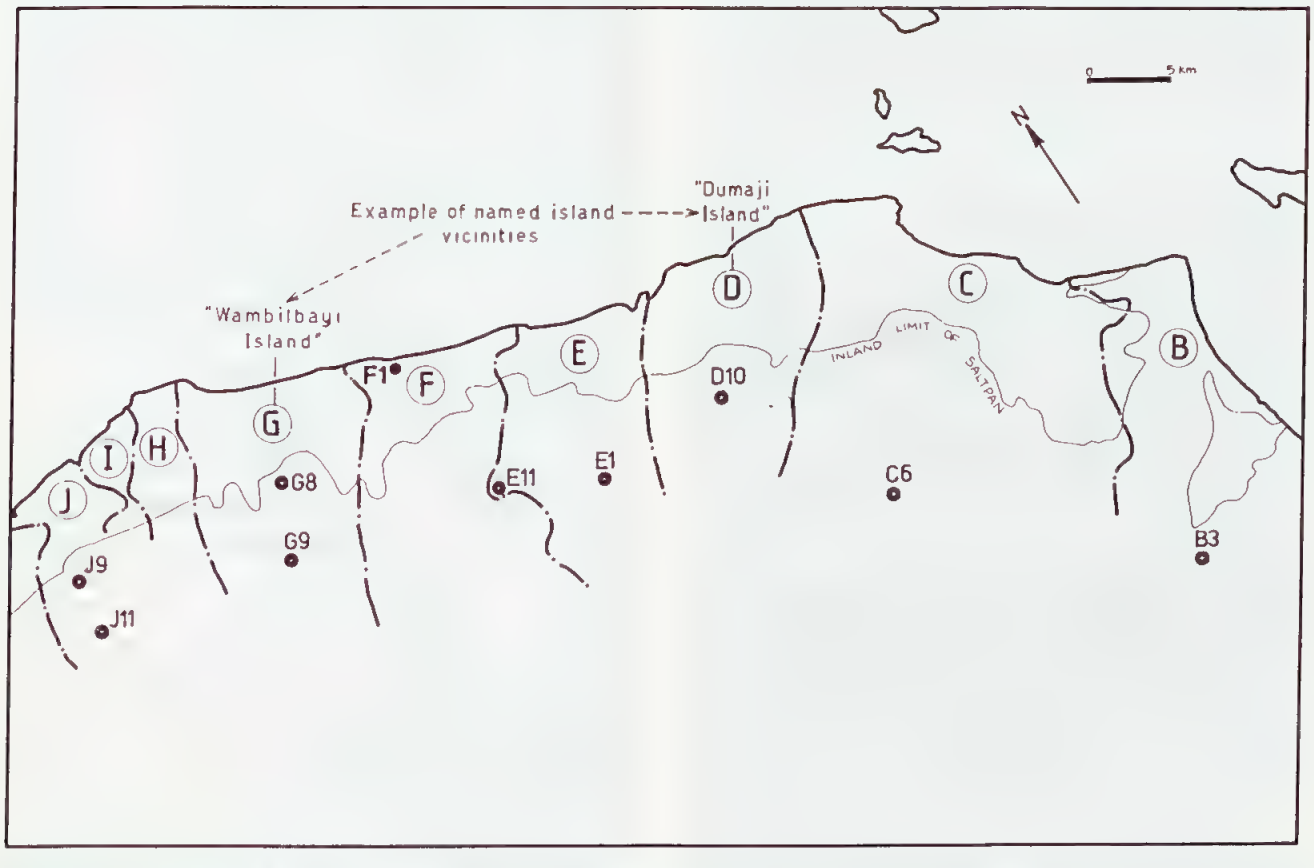

FIGURE 3. Ganggalida and Gananggalinda coastal estates showing the Aboriginal designation of the inland limit of the saltpan areas as the beginning of the 'mainland' (*wambalda*). Certain fresh water holes on the 'mainland' are shown for each estate.

to have moved in and out of it constantly. Nevertheless, it was viewed as the distinctive domain appropriate to a conceptually separable group of 'saltwater people'.

Kinship and Social Organisation

An Aranda type kinship system appears to have operated traditionally throughout the study region. See Trigger (1985) for some discussion of its nature, and also comments by Warner (1933: 68), Sharp (1935: 160–161) and Hale (1982). Evans (1985: 17–18, 481–492) elaborates the Gayardild system of Bentinck Island and it is clearly of the same type as both others throughout the Wellesley Islands and also as Ganggalida, Garawa and Waanyi on the mainland; Tindale's failure to consider the issue of this similarity (1977: 258–260) again renders his general suggestions about the lengthy isolation of the Bentinck Islanders inadequate. Evans (1985: 21–22) in fact suggests 'a relatively short period of isolation' of the Gayardild (500 to 1000 years), based partly on this matter of kinship system similarity.

However, Tindale (1977: 258–259) does refer correctly to the marked lack of any system of named social categories (or 'class' system as he puts it) on Bentinck Island in comparison with elsewhere throughout the region, though his expression of this fact is at best imprecise in implying that the surrounding groups had 'sections'. Evans' expression of the comparison also lacks precision in suggesting that the Mornington Islanders and those on the adjacent mainland had moieties and sections (Evans 1985: 17). What has operated throughout the region, except on Bentinck Island, is a system of named subsections (Trigger 1985: 69–71, 350–351), though this system can be said to be 'organized as unnamed patrilineal semi-moieties and moieties' (Sharp 1935: 159; 1939: 455).

Putting aside the distinctiveness of the Bentinck Islanders in this respect, and without discussing social organisation in detail here, we may simply note the situation of the coastal mainlanders (Ganggalida). They were included within the mainland bloc stretching to the southwest in having both male and female subsection terms, and were only partly similar to the inhabitants of the North Wellesley Islands in that the latter had male subsection terms only (Sharp 1935: 162, fn. 4). They lacked the named semi-moiety terms which operated within at least the western parts of Garawa country (Sharp 1935, 1939; Reay 1962; Trigger 1987a).

The coastal Ganggalida also apparently lacked the institutionalised role distinction of 'ownership' and 'managership' in relation to land and ritual property, which operated to the southwest (Trigger 1985: Table 6). Although it is difficult to reconstruct their pre-contact ceremonial life because of more recent influences from the west, it is most likely that the coastal Ganggalida also lacked the major cult ceremonies in which the ownership/managership distinction is so important. In these respects, they were identical to the inhabitants of all the Wellesley Islands.

Genetic Evidence

Several publications have described similarities and differences of a genetic nature between North Wellesley Islanders, South Wellesley Islanders and mainlanders. Among other findings, Simmons *et al.* (1962) discuss the unusually high B blood group gene frequencies among the Bentinck Islanders, as compared with groups in the North Wellesley Islands. However, in later work, Simmons *et al.* (1964) did further comparisons with nearby mainlanders and concluded that the 'Karawa' also had a high frequency of this gene, and in fact have been 'a main source in the spread of the B gene in the mainland tribes of this remote area' (p. 68).

This discussion about certain genetic features of the Garawa people is not without methodological problems.[7] However, the relevant point to be considered here concerns claims based on this genetic evidence by Tindale (1977: 254–255). He asserts that the 'Karawa' constituted a 'small separate and isolated tribal enclave', and lived in a 'perhaps refuge area'. These assertions fit with Tindale's suggestion that the 'Karawa', like the Bentinck Islanders (and one other very distant north Queensland group) with whom they apparently share certain blood type characteristics, are 'relicts' of a previously more widespread population with this blood-type. Elsewhere, Tindale (1974: 122) himself notes that his speculation that the name 'Karawa' can be translated as 'uplanders' or 'hills people', is 'hazardous'. This is also the case for his other speculations about this group. Neither the sociocultural evidence nor the mapped distribution of Garawa estates in my data, support the suggestion that Garawa people have been in any way isolated, although oral tradition must be regarded as not necessarily providing precise information for historical periods greater than perhaps four generations. Reay's (1962: 95) comments about there 'always' having been 'a great deal of contact, including inter-marriage, between Garawa and Anyula [Yanyula]', are similarly based on ethnographic data. However, inter-marriage between these two language groups has also been indicated in genetic studies carried out by White (1978: 42; 1979: 439, 445).

To summarise the discussion so far, the coastal mainlanders have been shown to be part of a linguistic sub-group extending throughout the Wellesley Islands, and inland for a substantial distance (at least 100 km southwards to the

Nicholson River). To the west and south-west, neither Garawa nor Waanyi (nor Yanyula on the coast) are within this linguistic sub-group. A narrow coastal strip adjacent to the Wellesley Islands is classified in the Aboriginal view as containing areas which are environmentally similar to close off-shore islands, and is conceived as the separate domain appropriate to 'saltwater people'. Nevertheless, substantial movement occurred between coast and adjacent inland, as well as between the coast and the North Wellesley Islands. The fact that the Gayardild in the South Wellesley Islands shared language and kinship system with others on the mainland and in the North Wellesley Islands, means that it is problematic just how isolated these particular islands were. The same type of kinship system extends throughout the study region, however there are differences in the presence of systems of named social categories. Finally, published genetic data assert various differences and similarities between populations in the study region. While there has been a suggestion that the Gayardild (Bentinck Islanders) and the Garawa may be 'relict' groups of a previously more widespread population, ethnographic and certain genetic data indicate a lack of isolation of the Garawa.

Thus, my evidence certainly does not indicate any simple pattern of relationships between the various groups and cultural forms treated so far. We are confronted with a complex pattern of overlapping cultural forms extending throughout inland, coastal and island societies. The paper now turns to a detailed consideration of some aspects of material culture. The evidence here indicates major differences between coastal mainland and the inland Garawa/Waanyi traditions. In a number of respects, the coastal mainland traditions resemble those of the off-shore islands (particularly the North Wellesley Islands), in their differences from Garawa and Waanyi traditions.

Diversity in Inland, Coastal and Islands Material Culture

In this section I discuss a form of decorative marking, the use of (and attribution of meaning to) shell material, spearthrowers, spears, fishing artefacts and technology, and watercraft.

Decorative marking

The marking known as *jinanggliyari* in Garawa/Waanyi is said to be absent from items traditionally produced in 'saltwater country', including both the mainland coastal area and the off-shore Wellesley Islands. The marking is a longitudinal fluted pattern made by an end of the adze-type tool known as *biynmala*. This tool consists of a gently curved stick of varying length with stone blades attached at both ends. One end is typically said to be a broad blade (known as *gubija*), while the more pointed blade is known as *jinangyi*, hence the name given to the mark it makes.

Roth (1904: 20) refers to this tool as a 'native gouge'. He presents figures showing it and the manner of its use (1904: Plate XIV, Figs 101, 105), and notes 'the Lawn Hill [Station] name' as '*gobija*'. He does not, however, distinguish between the two ends of the implement; although the figure he gives elsewhere (1897, Plate XII, Fig. 235) for areas to the south of the study region, possibly indicates the blade at one end as broader than the other. In dealing with this implement for areas to the west of the study region, Spencer & Gillen (1904: 636–640) describe considerable variation in the size and shape of the attached stone flakes, and discuss the consequent different sizes of fluting made by the implement. Contemporary Garawa and Waanyi older people explain that the *jinanggliyari* mark was commonly applied to the convex side of two kinds of boomerangs: *juguli*, near-symmetrical shaped for hunting (QM QE621[8]), and *man.guburana*, hook-shaped for fighting (QM QE4274). The marking was also applied to wooden coolamons, *jugiya* (QM QE51), and sometimes to other items such as spears, clubs and shields (Fig. 4). It is said to have helped ensure that a weapon would 'fly straight', particularly when combined with the right song (cf. Roth's [1897: 146] comment concerning spears).

From the inland perspective, the mark described above distinguished the item as belonging to the network of language groups stretching to the west from, and including, Garawa and Waanyi country; although it is clear from Roth's account, that it was

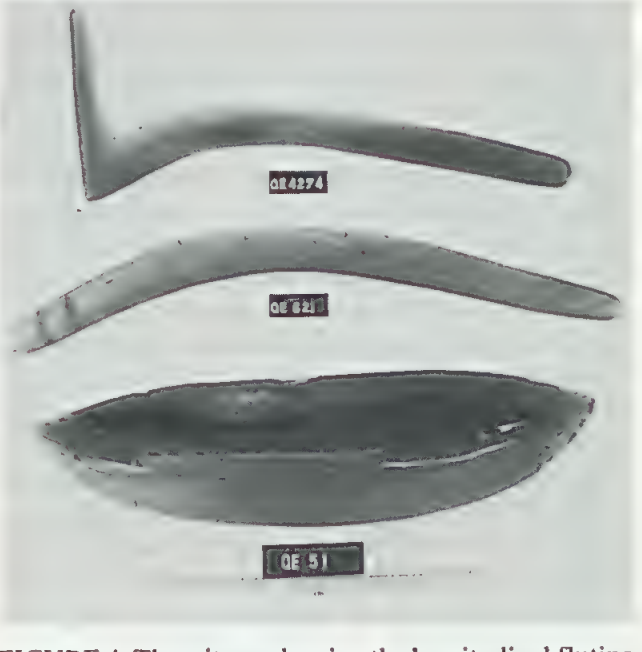

FIGURE 4. Three items showing the longitudinal fluting mark known as *jinanggliyari*, which is absent from items both on the coastal mainland and the Wellesley Islands. (Courtesy Queensland Museum.)

also used in areas well to the south of the study region (see also Mulvaney's [1976: 81] summary map showing its distribution to the south and west of the study region). Items with this mark may have been traded to the coastal 'saltwater country' (and to the North Wellesley Islands) but the mark was apparently not used by coastal artisans. Nor is it likely that coastal people commonly used the tool which made the mark. It is absent from Memmott's (1979a) list of the Mornington Island artefact repertoire. Memmott (1979a: 111) does state the contemporary claim by some 'Lardil' people that the practice of inscribing fluting on hooked boomerangs 'was obtained from the mainland in recent history', and coastal mainlanders may also have partially incorporated the marking during post-contact times. Memmott (1979a: 113) also notes the wooden coolamon as of possible recent mainland origin, and like the 'Lardil', coastal Ganggalida people appear to have only made coolamons from *Melaleuca* bark (Roth's 'pleat-type' [1904: 30]), in pre-contact times.[9] The adze tool which was absent from the islands and the coastal mainland repertoires, was the implement typically used in inland areas to gouge out wooden coolamons, as well as to inscribe the fluted mark on them.

Shell material

Shell material is of course plentiful in the coastal environment, and the fourteen Ganggalida classifications that I have recorded represent only a portion of such knowledge. By contrast, the inland perspective appears to regard 'saltwater shell' as belonging to two broad size categories only: *rabunya* — 'big one' and *malduwa* — 'small one'. An example of the former is the large 'bailer shell' (*Melo Amphora*) used for carrying water (eg QM QE593, obtained from Allen Island). Roth (1904: 29) notes that on the Wellesley Islands 'the ventral surface of the last whorl of the . . . shell is pierced for insertion of the thumb during transport'. Garawa and Waanyi people are said to have not customarily used this item. Inlanders know that coastal people used both *malduwa* and *rabunya* saltwater shells to construct small and larger (respectively) cutting and scraping implements, and this is seen as having been necessary and appropriate due to their lack of suitable stone material. Freshwater mussel shell was apparently used similarly, but only to a limited extent, in the inland areas. Shellfish also formed a more substantial part of the coastal diet, as compared with the inland diet.

However, the difference in use of shell material that inland people today remark upon, is the coastal people's lack of shell pendants known by inlanders as *jaramara* (QM QE1809, obtained from the Lawn Hill–Nicholson River area in 1900). This item is pearl-shell (*Pinctada maxima*), as are the others in several museum collections identified by an inland man as *jaramara*.[10] These pearl-shell pendants were received by Garawa and Waanyi people from areas to the west and were considered items of great significance. Their general importance appears to have been as a marker of certain formal social roles. For example, two individuals 'promised' to each other as marriage partners wore *jaramara* (for a short time at least) on the occasion of the promise being formally and ritually recognised. A further example is a woman wearing the item following her child's death, particularly in any associated ritual settings. The *jaramara* thus marks its wearer as the focus of ritual related to an important social situation. Occasionally, there may be a scratching or engraving on it which may indicate the tie to a particular person. For example, such a scratching on the QM specimen noted above was interpreted as representing the hand and extended fingers of its custodian. These items are inherited from parents, grandparents and other kin depending on circumstances. While not always considered highly secret, access to them is restricted.

It is thus the exclusion of coastal people from the customary receipt of these items from west of the study region, which distinguishes them from the inlanders. Senior Garawa and Waanyi people now say that the items were not passed on to Ganggalida people 'because they didn't know'. In these respects, the situation of the coastal mainlanders was identical with that of the Wellesley Islanders.[11]

Spearthrowers

While inland artisans made three types of spearthrower, the coastal people along with all the occupants of the Wellesley Islands, made only one of these. It is known in Garawa, Waanyi and Ganggalida as *murrugu*, and Memmott (1979a: 110) reports the same term ('*murraku*') for 'Lardil'. It is cut from one straight piece of cylindrical wood so that the distal end has a raised notch which slips into the hole typically at the back of spears (QM QE16/113, see Fig. 5). Roth (1909: 200) describes it in some detail and refers to it as 'a very primitive form of implement met with in the Wellesley Islands, and on the adjoining mainland in the neighbourhood of Burketown . . .', and illustrates it in his Plate LVIII, Fig. 14 (and see also Roth 1902: 15). As Roth mentions, this is a very light implement; contemporary people say it is commonly made from the *larrgulda* tree (*Thespesia populneoides*), or one of several other light woods. Presumably Roth designates it as 'primitive' because of the notion that its construction is simple relative

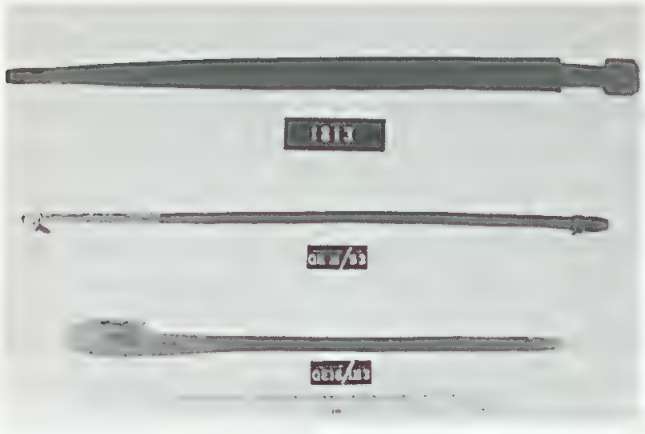

FIGURE 5. Three types of spearthrower made in the study region. The bottom one (QE 16/1113) was made throughout mainland coast, island and inland areas, while the other two were made only in the inland areas. (Courtesy Queensland Museum.)

to other types, or at least somehow less developed. This is further made clear when he notes (1902: 15) that it is identical (except in its size) with a 'toy wommera' used commonly throughout north Queensland by boys emulating the fighting behaviour of men. However, both coastal and inland people state its advantage over other types of spearthrower to be that there is no problem with a separate attached peg coming loose. It can not be seen as under-developed in terms of functional performance.

The two further types of spearthrowers made and used by Garawa and Waanyi people, but not in the coastal mainland area or on the islands, are termed *ngaliga* and *wujula*. The former is again a cylindrical straight piece of wood, but with a separate wooden peg (known in Garawa/Waanyi as *ngurru*) attached to the distal end, usually with gum (QM QE11/53, obtained from Turn Off Lagoon on the Nicholson River). The latter type is flat and linear with a large notch forming a spatulate proximal end. The peg is attached to the distal end at an acute angle to the face (Robins 1980: 58), (UQ 1813; see Fig. 5). Roth (1909: Plate LXI, Figs 1–4) describes these two types and notes (pp. 200–201) them as 'occasionally to be found in the area around Burketown, but ... certainly not of local manufacture, being brought in from eastward'. However, I am sure the editor's footnote replacing 'eastward' with 'westward and southward' represents what Roth intended; though it can be noted that the editor's correction was overlooked in McCarthy (1939: 419). My information is certainly that these two latter types were made and used in Garawa and Waanyi territory to the west and southwest of Burketown.

Spencer & Gillen (1904: 668–670) describe and illustrate the *ngaliga* type as often found to the west of the study region, and state that it is traded 'eastwards towards the Gulf'. The one they illustrate is in fact from the 'Anula [Yanyula] tribe' so the type apparently reached the saltwater domain to the west of the coastal Ganggalida area. It is shown with a human hair-string tassel at the handle end, and, although Roth (1909: 201 and Plate LXI) also shows such a tassel, this is now said not to have normally been added by Garawa and Waanyi people. In another publication, Spencer & Gillen (1969 [1899]: 578–582) give the name for this type (said to be made by 'the Waimbia [Wambaya] tribe') as *'Nulliga'*, clearly the same term as *ngaliga* given above. In both publications, Spencer & Gillen also show the *wujula* type in areas to the west of Garawa and Waanyi territory.

While neither of these latter two types are now said to have been customarily manufactured by coastal people or Wellesley Islanders, some coastal incorporation of these items and the skills to make them did occur during post-contact times. One museum specimen (UQ 1814) of the *ngaliga* type obtained in the 1940s, is recorded as having been made by a man at Mornington Island who learned about the style from mainland sources.[12]

Spears

Four types of spear can be distinguished. In general, spear shafts are now commonly known as *mugura*, but are distinguished according to the kind of tree they are cut from. However, spear types are distinguished mainly according to the nature of their heads.

The first type was used throughout inland, coast and island settings; it is known by the word for prong in all languages, and usually two or three prongs are attached to a shaft (QM QE11/53, see Fig. 6). The manner of construction described and illustrated by Roth (1909: 190–191) for the Wellesley Islands, appears applicable to both the coastal Ganggalida and the inland Garawa and Waanyi. (However, with the incorporation of European wire, the prongs have been commonly attached by wedging them into a hole made in the end of the shaft.) To summarise the earlier technique, the wooden prongs are fitted neatly against grooves cut along the shaft and then tied with string. These spears were used mainly for fish, but also for animals such as goanna in some circumstances, in both coastal and inland contexts.

The second type of spear head (*babagana* [Garawa] and *jimindi* [Waanyi], but not known by a term in Ganggalida) is stone, and the spear was used to hunt large animals like kangaroo and emu (QM QE4278, obtained in the Burketown area). The stone items are said not to have been manufactured in the coastal area, but were apparently procured by coastal people from various inland sources. They were thus used by inland and coastal people both as knives and as spear heads fitted to shafts (cf.

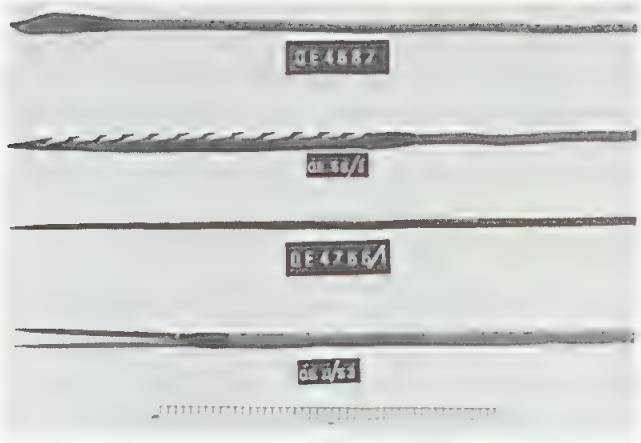

FIGURE 6. Four types of spear made in the region. The QE 4766/1 type was not used in inland areas, while the stone flakes for the QE4687 type had to be imported into the coastal area. (Courtesy Queensland Museum.)

Spencer & Gillen's [1969 (1899): 592–593; 1904: 640–656] accounts of the manufacture of these stone blades and their multiple uses, upon which McCarthy [1976: 35] appears to rely). Roth (1904: 18, 22) notes that the stone blades were made 'along the ranges up the western border north from Lawn Hill, etc.', and that small bundles of them rolled up in tea-tree bark were bartered. He specifically mentions (1909: 190) 'the stone-spears of Burketown, Point Parker [i.e. coastal Ganggalida country], and the ranges along the Queensland Northern Territory Border [i.e. inland Garawa/Waanyi country]'; and, it may be noted, he also comments (1904: 22) on a 'large import' of such items occurring 'from the Northern Territory, across the border from Wollogorang [Station] southwards' to his North-West-Central districts.

Tindale (1974: 122, 228) states that 'Karawa' people traded stone knife blades to the east generally, and that Mornington Islanders sent young marriageable girls in return for these items. He also mentions McCourt's claim (published soon after [McCourt 1975: 80, 108]) to have discovered the origin of the long stone spear points found by Tindale 'on Bentinck Island . . . and on the adjacent [mainland?] coastline'; McCourt says these were quarried and made in the Wollogorang-Calvert Hills Stations area, on the Calvert River, near Redbank Mine, etc., — that is, in Garawa territory. Contemporary old Garawa people certainly state that a number of places, including this area, were sources of stone used for both long knives and spear points. Indeed, they take pride in the Garawa knowledge of the manufacture of various kinds of stone tools.

However, how far the stone blades made in Garawa territory reached, remains an open question. Although a comment from Roth (1901a: 4) states that strong shell tools take the place of knives and scrapers on Bentinck Island, 'as on the mainland', his statement (quoted above) about the presence of stone spear-heads in coastal Ganggalida country is quite unambiguous. Yet none of Roth's data describe these items for the Wellesley Islands, nor does Memmott's (1979a) recent work with contemporary 'Lardil' people mention them. Thus, Tindale's assertion that the stone spear-blades reached Mornington Island may be incorrect. Tindale (1977: 267) himself notes that such stone items were never used on Bentinck Island, though he was shown one on Sweers Island which had been brought by visiting mainland Aborigines accompanying European men.

The third type of spear is known in Garawa and Waanyi as *ngarrgidigidi* (*ngarrgadaba* =to spear), (eg QM QE56/1, obtained from Turn Off Lagoon). The long wooden head is barbed on one or both sides, making it difficult to remove. This is a fighting spear, said to have been used in a variety of conflict and dispute contexts. Coastal Ganggalida people are said to have similarly used this spear. Memmott (1979a: 110) also describes it for the 'Lardil'.

The final type[13] was apparently not made or customarily used by the inland people. It consists of a light wood shaft attached to a long smooth hardwood point of approximately the same length as the shaft (QM QE4766, Nos 1–7). The method of attachment is apparently unusual (R. Robins, Queensland Museum, pers. comm.), being the hafting together of the two sticks whose ends have been sliced at much the same angles. The join is bound in a distinctive fashion and no gum is used. This method of attachment is quite different from that customarily used by inland people. The spear was used for large marine animals such as dugong and sea turtle and is known in Ganggalida as *miyalda*. Memmott (1979a: 110) describes the same spear for the 'Lardil' on Mornington, where it is known as *miya*.

Fishing and other methods of obtaining aquatic foods

Both inland and coastal people used pronged spears and nets to obtain a wide range of aquatic foods. A large amount of knowledge is particular to certain environments, and this is especially so in relation to 'saltwater country'. Yet coastal people clearly also used the same techniques as inlanders when ranging into the vicinity of fresh waterholes, for example, 'poisoning' techniques involving the placing of particular plants in the water, which cause fish to float to the surface where they can be easily obtained. As well, not all practices are the result of environmental determination. For example the 'squeezing' of stingray flesh in the coastal area or swordfish flesh in both saltwater and freshwater

areas, appears to be done solely because the taste of the meat is preferred without the 'sticky stuff' which comes out when it is squeezed.

Nets were used by both inlanders and coastal people. Despite size variation they were all made from string which was produced by rolling together either strands of certain grasses (QM QE1912), or strands of bark from certain trees — the bark of *Hibiscus tiliaceus* is particularly useful for this purpose in coastal areas, but other trees such as kurrajong (*Brachychiton* sp.) or black wattle (*Acacia hemsleyi*) are used throughout the study region. There are two methods of net usage in both coastal and inland areas. The first involves four people, one at each corner of a big net, dragging it so that two corners are held near the bottom and two at the surface, and the two ends are moved so that the net forms part of a circle, eventually dragging its contents on to the shore. In the second method, two sticks are attached to two sides of the net which is moved vertically through the water while other people frighten fish into it; when a weight is felt against the net, it is taken to the shore.[14]

It remains uncertain whether line and hook fishing was done in this region. Roth (1903: 5) states that 'before the advent of the Europeans, such articles in any material (shell, bone, etc.) were unknown'. Some Aboriginal people today agree with this view. Some remain unsure, and others claim that hooks and lines were in use prior to colonisation. Indeed, a shell type of hook certainly exists, obtained in 1882 from the Settlement Creek area (QM QE5924, see Fig. 7): a grass string line is attached to a groove cut around the top of the shank of a shell hook, and what are designated in the associated documentation as several shell sinkers, are tied to the line. Roth's (1901b: 20) general comment for other areas where he found usage of fish hooks, that weights or sinkers are never used, is thus also problematic. It seems most likely that the hook shown in Fig. 7 was an isolated recent import into the region, possibly originating from the Torres Strait Islands.[15]

The term *wardugu* has been given by several contemporary old people to refer to fishing lines complete with hook (cf. Keen's [1983: 294] translation of the term as 'fish, hook, wire, line'), and while the term *bala* is given for the hook itself, it is more generally applied to any kind of forked shape, whether as part of an implement or simply the fork formed by tree branches. Some people today, both inlanders and coastal people among them, state that hooks were also made from emu, kangaroo and pelican bone. One specific account from two older Garawa men is that 'goanna collar bone' and 'catfish jaw bone' are suitably hook shaped and were used as such by Garawa people.

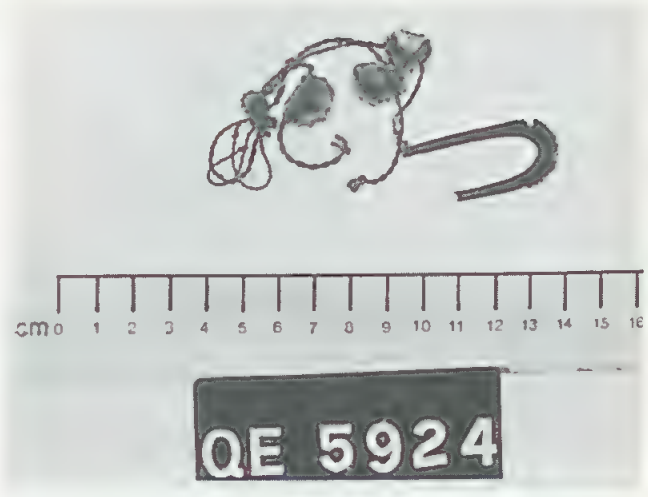

FIGURE 7. Fishing line with shell hook and sinkers, collected in 1882 in the Settlement Creek area. (Courtesy Queensland Museum.)

Various kinds of grub, frog, insect and shellfish are now used as fish bait, as well as the fruit from the fig tree (*Ficus racemosa*). If line fishing has indeed developed since the early phases of European impact, it represents an innovation which has occurred throughout inland, coastal and island settings.

Of particular interest in this region is a large complex of stone fish traps on the Wellesley Islands and the adjacent mainland coast. Stone walls as traps are said to have been constructed across inland watercourses at narrow places, and these were mainly used during 'flood time' (the wet season) when the stream ran strongly due to the extensive wet season rains. More temporary sapling fences were also constructed across both inland and coastal watercourses; in the coastal area stakes were stuck in the bed at an angle so that the receding tide would push deliberately placed bushes and other debris against them. However, the inland traps appear to have been much less important in the food production process than their coastal equivalents.

The extensiveness of the stone traps throughout the islands and adjacent mainland coast, suggest their importance in the food production process. Over approximately 470 km of coastline, 334 traps have been recorded, one trap per 1.4 km of coastline (although there is considerable variation in the density of traps throughout the islands and adjacent mainland); (see Robins *et al.* [n.d.] for details of the physical features of the traps, their distribution and relevant ethnographic data). Figure 8 shows one of the mainland trap sites (at Bayley Point). This series of traps extends along the shore-line for approximately 400 m, and from the shore-line up to approximately 150 m out on to mudflats, to the edge of an extending rock platform. The receding tide would leave contained (if not

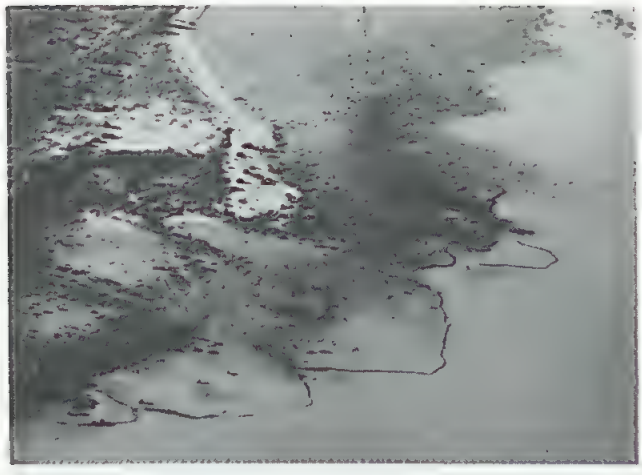

FIGURE 8. Stone fish trap complex at Bayley Point on the mainland coast opposite the Wellesley Islands. (Courtesy Connah/Jones Aerial Archaeology, University of New England.)

exposed in some instances) fishes (including shark and stingray), and at times sea turtle and dugong. On a visit to these traps in 1983, Ganggalida people also used a pronged spear to obtain crabs from within crevices under the trap wall. The stone wall traps represent a highly developed (and apparently durable) form of food production technology, which is distinctive of the coastal economy on the mainland and the Wellesley Islands.

Watercraft

The distinctive triangular shaped raft of the Wellesley Islands area (known in 'Lardil' as *walpa*) has been described in various sources (e.g. Memmott 1979a: 111). It is clear from contemporary accounts that these were also used by coastal mainlanders opposite the islands who refer to it as *walbuwa*. Roth (1908: 161) confirms this fact, and describes the raft as:

> formed of numerous logs of 'white mangrove' tied together at the butts as well as at the extremities, with the result that it is much narrower foreward than at the stern. On top is placed some sea-weed, a sort of cushion for the voyager to sit upon. With such frail craft the [Aborigines] will not only visit island and island, but even cross over to the mainland, usually on the one course, making for a spot somewhere in the vicinity of Point Parker.

Elsewhere, Roth (1903: 3) notes again that: 'There is no doubt whatever that communication goes on here [from Forsyth Island] between the mainland via Raines [later to be called Paines] and Bayley Islands and Bayley Point'.

Davidson (1935: 40), in his survey of Aboriginal watercraft, states that apart from in this relatively limited area of the southern Gulf of Carpentaria, this type of raft existed elsewhere only on a section of the north-western Australian coast, and the question of its advantages and disadvantages for those who adopted it remains an interesting research issue. Davidson (1935: 39–45) reconstructs an historical developmental sequence for watercraft where the triangular raft was invented earliest, but had then 'given way' along most of the northern Australian coast to the supposedly more sophisticated and preferred sewn bark and dug-out canoes. He makes no direct comment on why the raft was retained in two regions. However, a cautionary comment is surely required here against the notion that the rafts would have necessarily been inferior to the canoes. The point is similar to the one made above concerning Roth's attribution of primitiveness to the coastal (and islands) spearthrower. While the raft may appear to involve less sophisticated construction techniques than the canoes, an assumption that the canoes were better suited than rafts for travel in all circumstances may well overlook certain advantages possessed by the latter. For example, a feature of the rafts, particularly the larger ones, may have been greater stability which may have enabled safer transportation across shallow sandbanks and channels, of larger numbers of children and valued items (including burning cinders to be used to re-kindle fires).

Within the study region of this paper, Ganggalida people on the coast just to the west of the Wellesley Islands are said to have used the raft, but to a much more limited extent than the Gananggalinda people directly opposite the islands. It was not manufactured or used by the inlanders. Garawa people are said to have been familiar with the manufacture of the sewn bark canoe (termed by them *wulganyi*) from the bark of the messmate tree; however, they only used it occasionally, most likely when moving over wide sections of the lower reaches of such watercourses as the Robinson and Calvert Rivers and Settlement Creek. While Ganggalida has a similar term for this type of canoe (*wulganda*), the coastal people are said to have used it even less than Garawa people. No suitable messmate bark is apparently available in the coastal country. The sewn bark canoe was thus used only to a limited extent east of Yanyula territory, and the above data fill the gap mentioned by Davidson (1935: 35) concerning its distribution west of the Wellesley Islands.

It was the Yanyula people from the coastal areas far to the northwest of the Wellesley Islands, who are now regarded throughout the region as having been the experts with bark canoes. It was they also who came from the northwest in dug-out canoes, which had apparently diffused as far eastwards in the Gulf as the vicinity of the Sir Edward Pellew Islands in Yanyula territory, having been initially

introduced into northern Arnhem Land by Macassan visitors well prior to the European presence in the Gulf (Davidson 1935: 20–24). Dug-outs are now known generally by the same term, *muwarda*, as that given to all European-style boats regardless of their size. Whether Keen (1983: 278) is correct in asserting that this term (her '*muwata*') derives from the English word 'motor', it is most likely that dug-outs were known in the study area before motor-driven boats were brought in by Europeans. Contemporary coastal Ganggalida old people know how dug-outs were made from large-girthed trees of certain kinds (for example, *Canarium australianum*). However, while such trees may be found in their country, only a small number of dug-outs were apparently made here following the introduction of steel axes and the increased eastwards migration of Yanyula people with dug-outs after colonisation.

Material culture — a Summary

In summary, a longitudinal fluting mark was used in decoration by Garawa and Waanyi artisans, but not in the Ganggalida mainland coastal area nor in the Wellesley Islands. This mark is now recognised as distinguishing artefacts as belonging to the cultural bloc extending from Garawa and Waanyi territories to the west and southwest. The adze-type implement used to make the fluting was not manufactured in the coastal or island areas, and hence the wooden coolamon could also not be produced. There was no established stone tool working tradition on the coast or in the islands, whereas Garawa and Waanyi people speak with pride of the stone tool production techniques used in earlier times. Shell cutting tools appear to have taken the place of stone tools along the mainland coastal strip and in the islands. Pearl shell pendants were received by Garawa and Waanyi people through trade from far to the west and southwest, but these were not passed on to coastal Ganggalida people or to Wellesley Islanders.

Coastal mainlanders and Wellesley Islanders made only one type of spearthrower, whereas the inlanders produced two further types as well. Of the four spear types in the study region, two were used across inland, mainland coast and island areas, one was produced only on the coast and islands, and one (with a stone blade as the head) was produced only among inlanders, although mainland coastal people (and possibly North Wellesley Islanders) received the stone blades through trade to a certain extent.

Aquatic resources were obtained by use of spears and nets throughout all parts of the study region (and line fishing appears to have been adopted across the region, with the probable exception of the South Wellesley Islands, from early phases of European colonisation). Large stone wall fish traps were used only in mainland coastal areas and throughout the islands. Unlike both inlanders and Yanyula coastal people to the northwest, coastal Ganggalida people and Wellesley Islanders used only rafts as watercraft.

Conclusion

This paper has compared aspects of inland, coastal and island societies. The most detailed data have been given for traditional material culture, and this has indicated a substantial degree of similarity between coastal mainland and islands societies, compared with nearby inland society to the west and southwest. As 'saltwater people' occupying 'saltwater country', the coastal mainlanders can be regarded as part of the island cultural bloc in significant respects. Yet the material culture of coastal mainland society has simultaneously emerged as similar to that of inland society in *certain* respects, and if further aspects of material culture were to be studied closely, a number of differences between mainland coast and the islands could well become evident.[16] While the material culture repertoires of the mainland coast and islands are strikingly similar in significant ways, it would be inaccurate to define them collectively as a homogeneous material culture tradition completely separate from that of the inland.

The same point was made when summarising the comparative data for the region on language, kinship and social organisation, and genetics. The paper has described a complex pattern of overlapping cultural and other forms, with no area emerging as completely distinctive. This generalisation includes the situation of the Bentinck Islanders, despite the literature in support of their alleged lengthy isolation. At least wN⅝ ffdemonstrated otherwise, we must recognise that the differences between Gayardild society and that on the North Wellesley Islands and the coastal mainland, are apparently no more substantial than the differences between the mainland coast and inland.

The main concern of the paper has been to consider the situation of coastal mainland dwellers adjacent to major off-shore islands society. The generalisation of this paper is that the relationship with the North Wellesley Islands societies in particular, has reinforced the maintenance of cultural differences between coast and inland societies on the mainland. This is not to argue for uni-directional influence from the islands to the coastal mainland. Indeed, some of the data indicate major areal influence from the mainland to both the North and South Wellesley Islands (e.g. the existence of an Aranda type kinship system

throughout the study region). However, the North Wellesley Island societies should not be viewed as without influence on mainland coastal society. In this sense, I am arguing that those mainland-island relations which entail regular contact should be viewed as similar to relations among peoples on the mainland. It may be that the environmental similarities in this region between the mainland coast and parts of the off-shore islands, particularly engender the cultural similarities dealt with in this paper (especially in the aspects of material culture traditions which have been considered). However, the implication for studies in other regions is that when comparing island and mainland societies in Aboriginal Australia, particular attention should be paid to the environment and society of the immediately adjacent mainland coast, as well as to societies located further inland.

Endnotes

1. The name of this language has been given as 'Yukulta' in the literature (Keen 1983). However, the term 'Ganggalida' was predominantly used for the language and a group of people at the time of my research. The latter term can be translated as meaning 'language' or 'talk'; (see Trigger [1985: 340–49] for further discussion of the relationship between these two terms).

2. The language of the Mornington Islanders is more conventionally spelt 'Lardil' (see e.g. Memmott 1979b). However, except where quoting from works using this spelling, I will use the mainland Aboriginal expression 'Layardilda'.

3. Elsewhere (Trigger 1987b), I have dealt in detail with the problematic issues entailed in using language names to designate 'tribal' units in this region. In this paper, such expressions represent a predominant view among Aboriginal residents which glosses separable areas of land and associated bodies of tradition by the use of language names.

4. Indeed, Evans (1985: 7–8) describes the 'basic "isolation"' (i.e. distinctiveness) of the broader 'Tangkic subgroup' of languages, including those throughout the islands and Ganggalida and Nguburinji on the mainland, when compared with other Aboriginal languages.

5. Evans (pers. comm.) has speculated that the etymology of this term may be derived from *kanatya* — 'to burn' and *kalitya* — 'to jump' (see Keen 1983: 272); hence, these people may have been known by a term for 'flames jumping up' or bushfire at times visible from the vantage point of other coastal people.

6. This is not to imply that coastal mainlanders regarded even the small close off-shore islands (Bayley and Pains) as without environmental features differentiating them in more specific respects from the 'islands' in mainland 'saltwater country'. Certainly, the larger off-shore islands are much more diverse environments than both the smaller off-shore islands and the sand ridge 'island' areas within the mainland 'saltwater country'; (see Memmott [1979b: 45–65] for a discussion of the land forms and ecology for Mornington, and Tindale [1962a: 280–288] for relevant information concerning Bentinck). It would be interesting to investigate whether the larger off-shore islands are designated as 'islands' (*murndamurra*) in the coastal mainland perspective. Minimal data indicate that they are in fact regarded as *wambalda* (or 'land'), though coastal mainlanders would presumably identify as *murndamurra*, areas within the larger off-shore islands similar to the sand ridges in mainland 'saltwater country'.

7. Simmons *et al.* (1964: 75) themselves point out for the whole population tested in this region, that 'about one-half . . . were of mixed tribes and, of course, their earlier history is unknown'. Elsewhere (Trigger 1987b), I have discussed the necessity of examining the linguistic (or 'tribal') affiliations of individuals' four grandparents if this matter is to be adequately researched. The basis on which individuals state primary affiliation with, say, father's language rather than mother's, involves a variety of social factors. Hence the possibility of defining clearly a relatively enduring endogamous population in 'tribal' terms, from the statements of individuals, is fraught with difficulties.

8. Throughout the paper, items located in museum collections are identified by placing their registration identifications in parentheses. The letters 'QM' indicate that the item is in the Queensland Museum collection, and 'UQ' indicates the University of Queensland Anthropology Museum collection.

9. Roth obtained wooden coolamons at Burketown in 1901 and Forsyth and Mornington Islands in 1903 (items 13359, 13360, 13361 respectively, in the Australian Museum register of the Roth Collection), however it is most likely that these would have been manufactured in inland areas.

10. Mr Tommy George, of Waanyi and Garawa descent, inspected museum collections in Brisbane and Canberra in 1980 and in Brisbane during March 1984; some of the information he provided is contained in a transcription of an audio tape made after his 1984 work (George 1984).

11. Several authors (see Mulvaney's [1969: 96; 1976: 83] summary maps) have documented pearl-shell as an item traded over very long distances, and by these accounts it is possible that it also came into the study region from an easterly direction via Cape York Peninsula. However, it is rather the accounts of it coming originally from the very distant Kimberley coast (e.g. McCarthy 1939: 96–98) which are consistent with contemporary Aboriginal opinion in the study region.

12. Memmott (1979b: Table 7) notes 'wutjala' as the name given by 'Lardil' people to a spearthrower of the typical west Cape York kind with attached shells at the proximal end, and he says they reached Mornington Island only in recent times. While it appears the 'Lardil' have thus borrowed this term, both mainland coastal and inland groups remain unfamiliar with the Cape York type and

would most likely simply refer to it as being from 'another country'.

13. Roth (1902: 15) refers to a kind of toy spear used in games by young boys: 'so far observed . . . only among the coastal blacks to the west of Burketown, and at Wollogorang (Northern Territory border)'. However, while the few people of whom I have enquired state that it was used, I have no data to compare with Roth's description of it.

14. The large 'dugong net' described for the 'Lardil' by Memmott (1979a: 112, 118) does not appear to be known by contemporary Ganggalida people, though whether it was once used in the coastal mainland area remains uncertain.

15. The hook collected from the region (Fig. 7) appears to be of the 'bent pin' type which is discussed by Massola (1956: 11, 15) as having been possibly introduced from the Torres Strait. Anell (1955: 114–115) says that all fish hooks in Australia were 'undoubtedly' introduced from the Torres Strait, and suggests that this occurred 'relatively late', that is during the recent past.

16. Memmott's (1985) ongoing work comparing 'Lardil' and 'Kaiadilt' material culture repertoires indicates some significant differences between aspects of the material culture of the North and South Wellesley Islanders, the most striking being that the Gayardild had a much smaller number of artefacts. It is most likely that further research would indicate that the Gayardild also differed from the mainland coastal Ganggalida in this respect.

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THE FOSSIL HISTORY OF THE EMUS, *DROMAIUS* (AVES: DROMAIINAE)

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The oldest known emu is *Dromaius gidju* n. sp. from the medial Miocene Kutjamarpu fauna at Lake Ngapakaldi in northern South Australia. This form, based on a partial hind limb, is smaller and has relatively shorter and less mediolaterally compressed hind limb bones, and less reduction of the medial and lateral digits than in the living form. *D. gidju* thus appears to be less specialized for a cursorial lifestyle, being somewhat intermediate between the forest dwelling cassowaries and the highly cursorial living emu, *D. novaehollandiae*. Fossils from the Late Miocene and Early Pliocene may be allied to *D. gidju*, but more material is needed to allow confident assignment. *D. ocypus* from the medial Pliocene Palankarinna fauna at Lake Palankarinna, northern South Australia, is intermediate in size between *D. gidju* and *D. novaehollandiae*. In addition, its tarsometatarsus is decidedly shorter relative to width than that in *D. novaehollandiae*, thus indicating that it is not as highly adapted for a cursorial life as the living emu. Essentially all other emu fossils, Late Pliocene–Recent, appear to belong in *D. novaehollandiae* including: *D. 'patricius'*; *D. 'gracilipes'*; and *'Metapteryx bifrons'*; all defined originally by C.W. De Vis. The only exceptions are the King Island emu (*D. ater*) and the Kangaroo Island emu (*D. baudinianus*). Whether there was greater size variability in Pleistocene emu populations and whether a separate species of emu once inhabited Tasmania are problems yet to be resolved once larger collections of both living and fossil emus can be measured and analyzed.

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The living emu (*Dromaius novaehollandiae*) is the second largest living ground bird, exceeded only by the ostrich in size. Today and in the past, emus have been restricted to Australia, and their origins are not understood.

The fossil record of emus begins in the Miocene, with two now extinct species occurring one each in the Pliocene and the Miocene of northern South Australia. The Quaternary King Island and Kangaroo Island emus seem to belong in two separate species. All other fossil emus, mainly Pleistocene, however, are very similar to and most probably conspecific with the living *D. novaehollandiae*. It is very likely, however, that the history of emus on the Australian continent is much older than currently understood because of the general lack of a pre-Miocene terrestrial record.

Although the Pleistocene emus are currently indistinguishable from the living emu, the Tertiary species are distinct. The hind limb of the single Miocene form is not as cursorially adapted. This species has a tarsometatarsus that is shorter and more robust, and the lateral and medial digits of the foot are not as reduced as in the living emu.

This paper reviews fossil emu material and outlines the major evolutionary trends demonstrated by the dromaiines during the last 20 million years.

The following abbreviations are used:

AM	Australian Museum, Sydney
AMNH	American Museum of Natural History, New York
B.P.	Years before present
C.	Cranium, crania
Cor.	Coracoid
CSIRO	Commonwealth Scientific and Industrial Research Organization, Division of Wildlife and Rangelands Research, Canberra
d	Distal
diapop.	Diapophyses
est.	Estimated
F.	Femur
Fib.	Fibula
HM	Hunterian Museum, Glasgow
hum.	Humerus
juv	Juvenile
L	Left
M	Mandible
MM	Geological and Mining Museum, Sydney
NMV	Museum of Victoria, Melbourne
p	Proximal
Ph.	Phalanx, phalanges
postzyg.	Postzygapophyses
QM	Queensland Museum, Brisbane
QVM	Queen Victoria Museum and Art Gallery, Launceston
R(r)	Right
SAM	South Australian Museum, Adelaide
SIAM	Smithsonian Institution - American Museum of Natural History Expedition Field Numbers, Washington, D.C. and New York
Sk.	Skeleton(s), many skeletal elements
St.	Sternum
Syn.	Synsacrum

T2, T3, T4	Trochleae II, III, IV
Tib.	Tibiotarsus
Tmt.	Tarsometatarsus
V.	Vertebra(e)
UCMP	University of California, Museum of Paleontology, Berkeley
WAM	Western Australian Museum, Perth

Previous Work

There is surprisingly little in the literature concerning the fossil emus of Australia (see Table 1). The first reference to a specimen supposedly related to emus was, in fact, a moa, '*Dinornis queenslandiae*', described by De Vis (1884) from the Darling Downs, Queensland. Some later workers considered this specimen (e.g. Hutton 1893, Miller 1963) to be related to the emus and cassowaries. Scarlett (1969), however, found the fossil could be assigned to *Pachyornis elephantopus*, probably collected from a midden on South Island, New Zealand, and thus it is not a valid Australian record, and certainly not an emu.

In 1888 De Vis described a new species of emu, *Dromaius patricius*, from a proximal end of a right tibiotarsus (QM F5547) and the distal end of another tibiotarsus (QM F5548). In the same paper he provisionally referred a left coracoid (QM F1120) to the same species. These three fossils were from King Creek, Darling Downs, in south-eastern Queensland. De Vis (1892) considered the whole of the Darling Downs sediments to be much the same age, but it is now known that these fossil-bearing deposits represent a range of ages. The Chinchilla fauna is likely to be of Late Pliocene age. On the other hand, the Darling Downs fauna of the eastern part of the Downs, including King Creek, is of Late Pleistocene age (Woods 1960, Stirton *et al.* 1968, Rich 1979). Later De Vis (1892, 1905) also referred a femur fragment, three tarsometatarsi, and a partial synsacrum (QM F5549) to *D. patricius*. The referral of the synsacrum is especially noteworthy. De Vis considered that because of its size, the fragment must have been from a cassowary or an emu, but: 'as no extinct cassowary is known yet in Australia, it seems almost necessary to attribute the present fossil to the emu *D. patricius*' (De Vis 1905: 25).

In 1892 De Vis set up another species of emu, *Dromaius gracilipes*, based on a distal left tarsometatarsus (QM F1142). In the description De Vis omitted to note the location from which the specimen was collected, but the museum label associated with the specimen indicates that it was from the Darling Downs. In this article De Vis (1892) also described a supposed kiwi, '*Metapteryx bifrons*', again without giving a location.

Spencer (1906) described *D. minor* of King Island, Bass Strait, Tasmania. The previous existence of a separate species of emu on this island was almost simultaneously made by Legge (1907), but he withdrew the name. *D. minor* was redefined by Spencer & Kershaw (1910) as more specimens became available, and recently the taxonomic status of this species has been discussed by Parker (1984).

The status of the extinct Tasmanian emu is an as yet unresolved problem. Emus were introduced from the mainland in the 1800s, and interbreeding may have occurred (Howchin 1926). Le Souef (1903) gave the Tasmanian emu the specific name *D. diemenensis*. Ridpath & Moreau (1966) considered it a subspecies of *D. novaehollandiae*. The only fossils and recent specimens of *D. diemenensis* collected alive which are known to exist include a femur, a synsacrum, three tibiotarsi, two tarsometatarsi, a cervical vertebra, and a leg lacking the femur and part of digit II (all at QVM) (Scott 1924, 1932), and three eggs (in private collections) (Campbell 1900, Le Souef 1903, Spencer & Kershaw 1910, Dove 1926).

Anderson (1937) described an emu sternum, which is much thicker than those of the living *D. novaehollandiae*, from the Wellington Caves, New South Wales. He suggested it might possibly belong to *D. patricius*.

Miller (1962) restudied *Casuarius lydekkeri*, discussed earlier by Rothschild (1911). The type of the species is a distal right tibiotarsus (AM MF1268). The type locality has been variously given as Queensland, Cooma and Wellington Caves (Miller 1962), but its provenance is uncertain. Its preservation, however, is very unlike that of fossils from Wellington Caves. It is clearly a cassowary, however, and not an emu.

Miller (1963) described a new species of emu *Dromiceius* (=*Dromaius*) *ocypus* based on an essentially complete right tarsometatarsus (SAM P13444) from the Pliocene Mampuwordu Sands, Palankarinna fauna, Lake Palankarinna, South Australia. It is smaller than *D. novaehollandiae*. The tarsometatarsus is evidently the one referred to by Miller in Stirton *et al.* (1961) as a new species of emu with 'proportions of the bone . . . intermediate between those of the emu and the cassowary'.

Miller also assigned four phalanges (UCMP 56849, 60563, 94679, 94680) from Lake Kanunka (UCMP V-5772, Katipiri Sands or possibly Tirari Formation) to the Dromornithidae, possibly *Genyornis newtoni* (Stirton *et al.* 1961). As noted by Rich (1979), however, they actually belong in the genus *Dromaius*. Thus, no dromornithids are known from the Pliocene–Pleistocene Lake Kanunka fauna, and this adds another record for emus.

Rich (1979) refers a left femur (SAM P17104), from Brother's Island, South Australia to *Genyornis newtoni*, but it conforms in all respects to *Dromaius* and should be transferred to that taxon.

TABLE 1. Australian localities producing fossil emus (*Dromaius*).

Locality	Fossil Elements	Rock	Fauna	Age	References
Leaf locality, Lake Ngapakaldi, South Australia	*Tmt., d Tib., Pes Dromaius gidju*	Wipajiri Fm.	Kutjamarpu	Miocene	Stirton *et al.* 1967, 1968; Rich 1979.
Bullock Creek, Northern Territory	*Tmt., Tib. Dromaius* sp.	Camfield beds	Bullock Creek	Late Miocene	Rich 1979
Alcoota (including Rochow locality), Northern Territory	*Tmt.* frags., *Phs. Dromaius* sp.	Waite Fm.	Alcoota	Late Miocene	Woodburne 1967, Stirton *et al.* 1968, Rich 1979, Rich *et al.* 1982
Lawson-Daily Quarry, Lake Palankarinna, South Australia	*Tmt. Dromaius ocypus*; *Tib., F. Dromaius* cf. *ocypus*	Mampuwordu Sands	Palankarinna	Pliocene	Miller 1963, Rich 1979
Lake Kanunka, South Australia	*F., Ph., R., Tib., V. Dromaius novaehollandiae, Dromaius* sp.	Katipiri Sands	Kanunka	Late Pliocene or Early Pleistocene?	Rich 1975, 1979
Chinchilla, Queensland	*Syn., F., Tmt. Dromaius novaehollandiae*	Chinchilla Sands	Chinchilla	Early to Middle Pliocene	Woods 1960, Stirton *et al.* 1968, Rich *et al.* 1982
Darling Downs, Queensland	*Cor., F., Tib., Tmt. Dromaius novaehollandiae*	Unnamed	Darling Downs	Pleistocene	Woods 1960, Rich 1975, 1979
King Creek, Queensland	*Dromaius novaehollandiae*	Unnamed	King Creek	Late Pleistocene	Baird 1986
Thorlindah, Paroo River, Queensland	*Tib. Dromasius novaehollandiae*	Unnamed	Unnamed	Pleistocene	Etheridge, 1889, Rich 1975, 1979
Bingara, New South Wales	*V., Syn., Tib. Dromaius novaehollandiae, Dromaius* sp.	Unnamed	Bingara	Pleistocene	Anderson 1889, Rich 1975, Marcus 1976
Lake Menindee, New South Wales	*Ph., Tib. Dromaius novaehollandiae*	Unnamed sand lunette	Unnamed	Late Pleistocene	Tedford 1967
Lake Tandou, New South Wales	*Dromaius* sp.	Unnamed	Unnamed	Pleistocene	Rich 1975
Wellington Caves, New South Wales	*Tib. Casuarius lydekkeri; St., Tib., Tmt. Dromaius novaehollandiae, Dromaius* sp.	Unnamed cave sediments	Unnamed	Quaternary	David 1950, Rich 1979, Dawson pers. comm.
Wombeyan Quarry Cave, New South Wales	*Tib., Tmt. Dromaius novaehollandiae*	Unnamed cave sediments	Unnamed	Late Pleistocene	Hope 1971, Rich 1975
?Baldina Creek, near Burra, South Australia	*F. Dromaius* sp.	Unnamed	Unnamed	Quaternary	S.A.M. Museum label
Brothers Island, South Australia	*F. Dromaius novaehollandiae*	Unnamed aeolianite	Unnamed	Quaternary	Rich 1975, 1979

Locality	Fossil Elements	Rock	Fauna	Age	References
Cooper Creek, (includes Katipiri Waterhole and Wurdulumankula), South Australia	*F,M Tmt., Syn., V. Dromaius* sp. Dromaiinae	Katipiri Sands	Malkuni	Pliocene-Quaternary	Stirton *et al.* 1961, Rich 1975
Kangaroo Island, South Australia (Several localities)	*Sk.. Dromaius baudinianus*	Unnamed	Unnamed	Quaternary	Morgan & Sutton 1928, Rich 1975, Parker 1984
Lake Callabonna (lower stratigraphic level), South Australia	*C., Syn., V., F., Tib. Dromaius novae-hollandiae*	Millyera	Lake Callabonna	Pleistocene	Stirling & Zeitz 1900, Rich 1975, 1979
Lake Kittakittaooloo, South Australia	*Tmt. Dromaius novae-hollandiae*	Katipiri Sands	Malkuni	Quaternary	S.I.A.M. Museum label
Naracoorte (Henschkes Bone Dig and Victoria Fossil Cave) South Australia	*M., V., R., Hum., Syn., F., Tib., Tmt.,* phs. *Dromaius novae-hollandiae, Dromaius* sp.	Unnamed cave sediments	Unnamed	Pleistocene	van Tets & Smith 1974
Salt Creek, South Australia	*F.* frag. *Dromaius* cf. *novae-hollandiae*	Unnamed	Unnamed	Quaternary	Rich 1975
Warburton River, South Australia (includes Green Bluff locality and Kalamurina).	*Syn., Tib., Tmt. Dromaius* sp.	Katipiri Sands	Malkuni	Quaternary	Rich 1975
Bone Cave, Western Australia	*Tib., Tmt. Dromaius novae-hollandiae*	Unnamed cave sediments	Unnamed	Quaternary	
A cave north of Moore River, Western Australia	*Tmt. Dromaius novae-hollandiae*	Unnamed	Unnamed	Quaternary	Rich (unpublished, 1971, field notes)
Irishtown, Tasmania	*Tib. Dromaius diemenen-sis.* Needs review	Unnamed	Unnamed	Quaternary	Scott 1924
King Island, Bass Strait, Tasmania	*Sk. Dromaius minor*	Unnamed sand rock and dunes	Unnamed	Quaternary	Spencer 1906, Spencer & Kershaw 1910, Jennings 1959, Parker 1984, Rich 1975
Mole Creek, Tasmania	*Tib. Dromaius diemenensis.* Needs review	Unnamed	Unnamed	Quaternary	Scott 1932
Moybray Swamp, Smithton, Tasmania	*Syn., V., F., Tib.,* tmts. *Dromaius diemenensis.* Needs review	Unnamed	Unnamed	Quaternary	Scott 1932
Scotchtown Cave, Tasmania	*C. Dromaius diemenensis.* Needs review	Unnamed	Unnamed	Quaternary	Gill & Banks, 1956

Locality	Fossil Elements	Rock	Fauna	Age	References
Lancefield, Victoria	*Tib., Tmt., Ph. Dromaius novae-hollandiae*	Unnamed	Unnamed	Pleistocene (26 000 B.P.)	Gillespie *et al.* 1978
McEachern's Cave, Victoria	Many skeletal elements *Dromaius novae-hollandiae*	Unnamed	Unnamed	Quaternary	McNamara pers. comm.
Buchan Caves, Trogdip Cave area, Victoria	*Tmt. Dromaius novae-hollandiae*	Unnamed	Unnamed	Quaternary	Rich 1975.

The bird remains in the Riversleigh fauna (Carl Creek Limestone) identified only as close to '*Dromiceius*' in Tedford (1967) have been determined by Rich (1979) to belong to a dromornithid, *Barawertornis tedfordi*, and thus are not a record of emu.

Stratigraphy
(see Table 1)

Only a few fossil sites producing emus have been found thus far, and most are of Pleistocene age. Fossils of a new species, *Dromaius gidju*, proposed in this paper, have been found at the Leaf Locality (UCMP V-6313) on the eastern shore of Lake Ngapakaldi, eastern Lake Eyre sub-basin, South Australia (Stirton *et al.* 1967). The sediments that outcrop here, known as the Wipajiri Formation, contain the Kutjamarpu fauna. Diprotodontid marsupials in this fauna are considered more primitive than those in the Beaumaris, Palankarinna, and Alcoota faunas, and have closest affinities with forms in the older Ngapakaldi fauna, known from localities listed in Stirton *et al.* (1968), in the Lake Eyre sub-basin and thought to be of medial Miocene age (Rich *et al.* 1982).

The Camfield beds at Bullock Creek (Bullock Creek fauna), Northern Territory, of probable Late Miocene age, have produced *Dromaius* sp. currently under study by P. V. Rich.

The Rochow locality (UCMP V-6349) at Alcoota, Northern Territory, near Alice Springs, has produced *Dromaius* remains that may be Miocene in age. But, as discussed by Rich (1979), the Waite Formation, which contains the Alcoota fauna, is not well dated at present. The diprotodont marsupials from this locale suggest a date younger than that represented by the Kutjamarpu fauna but older or contemporaneous with the Hamilton fauna. An unnamed rock unit containing the Hamilton fauna is capped by a basalt, which has been dated as 4.35 ± 0.01 m.y. B.P. (or Early Pliocene) by Turnbull *et al.* (1965) and Turnbull & Lundelius (1970). The sequence is underlain by marine sediments of the Grange Burn Formation assigned to the Kalimnan stage. At present Alcoota is viewed as Late Miocene in age.

Dromaius ocypus was recovered from the Lawson–Daily Quarry (or Lawson Quarry; UCMP V-5769) at Lake Palankarinna, eastern Lake Eyre Basin, South Australia (Miller 1963). The enclosing rocks, the Mampuwordu Sands, contain the Palankarinna fauna, and are overlain by the Tirari Formation and the Late Pliocene or Early Pleistocene Katipiri Sands containing the Malkuni fauna at Lake Palankarinna. An age of Middle to Late Pliocene is established by marsupial fossils, in particular *Zygomaturus*, which are more advanced than zygomaturines from Awe, Beaumaris, and Alcoota and yet more primitive than Pleistocene forms (Stirton *et al.* 1968).

Lake Kanunka (UCMP V-5772) in the eastern Lake Eyre sub-basin, South Australia, has also yielded *Dromaius* fossils. The Katipiri Sands or possibly Tirari Formation (see Rich 1979: 61) contains the Kanunka fauna dated as Pliocene or Early Pleistocene (Stirton *et al.* 1961, Rich *et al.* 1982, Tedford pers. comm. 1985).

The Chinchilla locality, south-eastern Queensland (Chinchilla Sands, Chinchilla fauna) also contains *Dromaius*. Several elements of the marsupial fauna appear more primitive than those in the Pleistocene eastern Darling Downs, and Woods (1960) assigned it a Pliocene age. Rich *et al.* (1982) consider Chinchilla to be Early to Middle Pliocene in age.

The distal part of a tarsometatarsus (AM F 58087) of an emu was found in the Australian Museum's 'old collection' and labelled 'mixed plus some from Lord Howe Island'. The fossil is very incomplete and appears to be from a juvenile individual. There are no reliable stratigraphic or locality data available for this form.

All of the other known fossiliferous sites producing emus are Pleistocene in age. For these

Pleistocene sites, as might be expected, some dates are better established than others. Deposition, for instance, of the Darling Downs sediments in Queensland may have occurred at several different times (Rich 1979) during the Pleistocene, and definite ages for specific sites are difficult to determine.

Thorlindah, on the Paroo River, Queensland, is thought by Rich (1979) to be 'probably Pleistocene . . . the bird remains were collected along with fragments of 'kangaroos' and *Diprotodon* (Stirling & Zeitz 1900: 44) in a well 20 feet deep'. *Diprotodon* appears to be restricted to the Pleistocene in all precisely dated situations. Emu material indistinguishable from the living forms is known from Thorlindah.

Vertebrate fossil-bearing localities at Lake Menindee adjacent to the Darling River and its major anabranch, western New South Wales, have been radiocarbon dated at 26 300 ± 1500 B.P. and 18 800 B.P. (Tedford 1967). Fossils of *Diprotodon, Thylacoleo, Phascolonus, Protemnodon* and macropodids have been recovered. UCMP localities V-5371, V-7185, V-67186 and V-67187 have produced *Dromaius* fossils. Hope (1978) discusses the stratigraphy of the Menindee area in some detail, with reference to the problem of dating the Pleistocene megafauna extinctions. At present the emu fossils from Menindee appear to be Late Pleistocene in age.

At Lake Tandou, New South Wales, several *Dromaius* fossils were found in archaeological excavations. Hope (pers. comm.) states that: 'there is now a reasonable stratigraphy for the lunette [at Lake Tandou], and a lot more dates; the oldest are in the order of 22 000–25 000; and lie at the base of the uppermost stratigraphic unit. The problem . . . is in working out where Harry's [Harry Allen, who collected the specimens while doing research toward a Ph.D. thesis] material came from'. Tentatively, a Pleistocene age seems appropriate for these fossils.

Bingara in New South Wales has produced vertebrae and a tibiotarsus of *Dromaius*. The bone bed occurs in a fluviatile clay deposit about 39–90 cm thick on the western side of Myall Creek. Remains of *Diprotodon* indicate a Pleistocene age (Anderson 1889).

Also in New South Wales, the Wombeyan Quarry Cave has yielded *Dromaius* fossils. This is not the same cave as Broom Cave or Guineacor Cave, also in the vicinity of Wombeyan. The Wombeyan Quarry Cave has not been radiocarbon dated, but Hope (1982) believes that it is of Late Pleistocene age. It seems likely that the quarry deposit is older than the 'Broom breccia', but both appear to be of Late Pleistocene age. Other fossils recovered from Wombeyan Quarry Cave include *Protemnodon, Sthenurus, Zygomaturus, Palorchestes, Thylacoleo carnifex, Sarcophilus laniarius,* and *Progura gallinacea*.

There are several bone producing caves in the Wellington Valley area of New South Wales. Different levels and different caves may have trapped animals at various times in the Pleistocene to Recent, perhaps even prior to this (L. Dawson pers. comm.) depending on when they were opened and resealed (David 1950, Tedford 1967). Emu fossils have been recovered from caves in this area.

Rich (1979: 58) states that *Dromaius* remains were recovered from Cuddie Springs (Mara Creek, SSE of Brewarrina, 16 km ESE of Gilgoin), New South Wales. Anderson & Fletcher (1934) do not mention *Dromaius* in their, admittedly incomplete, list of fossils recovered from this site. Wilkinson (1884) stated that: 'bones of *Diprotodon, Sthenurus, Macropus titan*, large wombats, large birds probably emus, crocodiles and a gigantic carnivorous lizard, *Notiosaurus* . . . are found only within a few yards of the centre of the spring'. Unfortunately, he does not describe or figure these bones, and the large birds may be *Genyornis*, specimens of which were later recovered by Anderson and Fletcher. MM F 19420, unlabelled when found in an old collection, has 'the style of preservation [suggesting] that it comes from Cuddie Springs' (Pickett pers. comm.) but is too large to be *Dromaius*. It appears, instead, to be the internal condyle of a tibiotarsus of a dromornithid, perhaps *Genyornis*. We have been unable to relocate the specimens Rich (1979) assigned to *Dromaius*.

Two Pleistocene cave deposits producing *Dromaius* fossils are known in Western Australia. A cave north of East Moore, Western Australia, has produced a tarsometatarsus of a juvenile emu (unregistered WAM). Bone Cave, near Jewel Cave, has produced an emu tibiotarsus and tarsometatarsus.

Four Pleistocene *Dromaius* localities are known from Tasmania. Scott (1924, 1932) reported a tibiotarsus from Irishtown, a tibiotarsus from Mole Creek, and several elements (a synsacrum, femur, tibiotarsus, two tarsometatarsi, and a cervical vertebra) from Mowbray Swamp, near Smithton, in western Tasmania. The Mowbray Swamp fossil site has been radiocarbon dated at greater than 37 780 B.P. (Gill & Banks 1956). Another Mr Scott found bones of the Tasmanian emu at Scotchtown Cave in association with '*Nototherium tasmanicum*', *Thylacoleo carnifex*, and *Palorchestes* (Gill & Banks 1956).

Dromaius minor is known from the Bass Strait island, King Island, Tasmania. Anderson (1914) was of the opinion that the original fossil matrix was a fairly hard, coarse, red-brown sand rock of shallow marine origin. Jennings (1959) stated that

the fossils occurred in windblown sand dunes of Pleistocene to Recent age and that finds from different geological horizons had likely been brought together by winnowing. Separate from the King Island form, the now extinct *Dromaius baudinianus*, is known from Kangaroo Island (Parker 1984).

Several localities along the south coast of Kangaroo Island (Cape du Couedic, Kelly Hill, Eleanor River, and The Brecknells) have produced fossil material (Morgan & Sutton 1928). Rich (1975) states that the age is Pleistocene.

Three Victorian sites, all Pleistocene in age, have produced fossil emus. A partial tarsometatarsus is known from Trogdip Cave, part of the Buchan Caves said by Rich (1975) to be Pleistocene because of the nature of the marsupial fauna also preserved in it.

Many fossils of the Australian megafauna have been recovered from a swamp near Lancefield, Victoria. As well as emus (less than 1% of the bones), *Macropus giganteus, Protemnodon, Sthenurus, Diprotodon*, and a dromornithid, probably *Genyornis*, were found. A sample of the bones themselves was radiocarbon dated at 19 800 ± 450 B.P., while charcoal in the channel fill in and upon which the fossil deposit rests provides a maximum age for the bones of 26 000 ± 500 B.P. (Gillespie *et al.* 1978).

A third Victorian site which has produced emu fossils is McEachern's Cave in western Victoria. According to Wakefield (1967, 1969), due to the funnel shape of the entrance the cave has acted as a death trap for terrestrial animals. Gravitational movement, movement of trapped animals and water action were responsible for considerable mixing of cave sediments. The fossils are Late Pleistocene to Recent in age. A sample of mammal bones from the top layer of the Pleistocene sediments gave a radiocarbon date of 15 200 ± 320 B.P. Extinct Pleistocene species found in the cave include *Sarcophilus laniarius, Zygomaturus trilobus, Thylacoleo carnifex, Sthenurus* spp. and *Protemnodon* cf. *brehus*.

The remaining sites from which fossil emus have been recovered are all South Australian. From Brothers Island, Coffin Bay, about 50 km WNW of Port Lincoln, a femur fragment SAM P17104, referred to *Genyornis newtoni* by Rich (1979) but actually *Dromaius*, was found in an unnamed aeolianite of sand and shells. As similar deposits on the island have produced *Sthenurus* cf. *brownei* (Tedford in Rich 1979), a Pleistocene age is indicated.

A number of Pleistocene localities collected by J. W. Gregory (1906) and later by joint expeditions from the University of California and the South Australian Museum, occur in the eastern Lake Eyre basin. The fossils were found as 'float' or in place in the Katipiri Sands, which contain the Malkuni fauna. Also collected by Gregory and later expeditions of the University of California and the South Australian Museum, are several localities on the Warburton River, including Green Bluff Locality (UCMP V-5771), Lookout Locality (UCMP V-5776) and Kalamurina. The Warburton River is in the eastern Lake Eyre sub-basin, and has produced fossils from the Katipiri Sands. A Smithsonian Institution–American Museum (SIAM) expedition in 1970 recovered a tarsometatarsal fragment (SIAM 75) of an emu from the Katipiri Sands (Malkuni fauna) at Lake Kittakittaooloo.

The Smithsonian Institution–American Museum Expedition and later a Museum of Victoria–Australian Army Expedition also recovered a number of *Dromaius* fossils from the lower level of Lake Callabonna in South Australia. This stratigraphic unit producing the emus also contained *Genyornis newtoni, Diprotodon optatum, Phascolonus gigas, Sthenurus, Protemnodon*, and *Macropus* (Stirling & Zeitz 1900, Rich 1979) and has been dated at greater than 40 000 B.P. (Tedford 1967), but sometime during the Pleistocene.

An incomplete femur (SAM P17103) bearing the museum label: '?*Genyornis*. Pleistocene locality unknown, possibly Baldina Creek near Burra, South Australia' is actually *Dromaius*. If the location is in fact Baldina Creek, a Pleistocene age is suggested by the occurrence of known *Genyornis newtoni* (Rich 1979) and *Diprotodon* at this site (Stirling & Zeitz 1900).

Several fossils of *Dromaius* were collected near Burra, South Australia by Mr R. E. Ireland and forwarded by the police department on 12 March 1935 to the South Australian Museum. They were found in a sandhill in association with Aboriginal (*Homo sapiens*) bones, SAM A25805 (information from museum label). The Aboriginal remains suggest a Pleistocene to Recent age.

Two caves near Naracoorte (about 320 km SE of Adelaide near the Victorian border), South Australia, have produced *Dromaius*: Victoria Fossil Cave (van Tets & Smith 1974) and Henschke's Bone Dig. Sediments producing the fossils in Henschke's Bone Dig have been radiocarbon dated at about 33 800 B.P. (van Tets 1974). Smith (1971) stated that the bones in Victoria Fossil Cave are most abundant in the top 15 cm of the damp, friable, light brown earth forming the floor of the cave. She also states that the abundance of sthenurines, diprotodontids, and *Thylacoleo* suggests that the deposit was formed sometime during the Pleistocene and sealed before the Recent. Wells *et al.* (1984) provide a complete discussion of current dates from this site.

Systematics

Only those features exhibited by the fossil specimens are discussed. For measurements see Table 2.

Family **CASUARIIDAE** Brisson

Members of the Casuariidae have a pterygoid that is inflated where it contacts the palatine; a palatine with a short shaft and an expanded medial plate; a long vomer; a palate that lies ventral to the parasphenoid rostrum and makes contact with the braincase only at the basipterygoid processes; maxillopalatines that are cone-shaped and open posteriorly; the cervical vertebrae are antero-posteriorly compressed; the atlas possesses lateral spines or occasionally complete vertebrarterial canals; the sternum is longer than wide with lateral margins concave laterally and has short, dorsally-directed sternocoracoidal processes and no sternal notches; the costal margin forms about 50% of the lateral margin; the antitrochanter of the synsacrum is located at the anteroposterior mid-point of the synsacrum; the ilium, ischium and pubis are subequal in posterior extent; neither the pubes nor the ischia are fused posteriorly along the mid-line; the ischium is deeper than the pubis; the ilium dorsal to the acetabulum is deep; the trochanter and head of the femur are subequal in proximal extent; the external condyle extends only moderately distal to the internal condyle; the popliteal fossa is elliptical and of moderate width; the distal depth and width of the femur are subequal; the posterior margin of the proximal articular surface is highly concave anteriorly; the external condyle and fibular condyle are subequal in breadth or the fibular condyle is broader; the cnemial crests of the tibiotarsus are little compressed mediolaterally; the inner cnemial crest extends far proximally to the proximal articular surface; the external articular surface extends far laterally; the margin of the external condyle is semicircular in lateral view; the tibiotarsus lacks a supratendinal bridge and also lacks an intercondylar eminence; the hypotarsus of the tarsometatarsus is narrow and centrally located; the hypotarsus extends decidedly further proximally than the intercotylar prominence; the internal cotyla is deeper than the external; the posterior shaft surface is deeply grooved; the anterior metatarsal groove is deep and extends the length of the shaft; trochlea IV extends distal to trochlea II; trochlea III extends distal to trochleae II and IV; the phalangeal count for digits II, III, IV is 3-4-5; of the proximal phalanges that of digit III is longest; that of digit IV is shortest; the unguals are generally claw-like, except for the elongated ungual of digit II in *Casuarius*.

Subfamily **DROMAIINAE** Vieillot

Within the Casuariidae there are a number of characters which reliably distinguish *Dromaius* from *Casuarius*, the only other member of the family. In *Dromaius* the mandible is broad and rounded distally, not narrow and pointed distally; the mandibular articulation of the quadrate is step-shaped, with the external facet decidedly more excavated (in *Casuarius* the facets of the mandibular articulation of the quadrate are subequal); the pterygoid is not excavated dorsally; and the palatine and vomer are decidedly shorter than in *Casuarius*; the semicircular notch in the prearticular surface of the atlas is shallow and narrow, not deep and broad; the axis is longer, and the hypapophysis not as deep as in *Casuarius*; the cervical vertebrae possess long, not short, styloid ribs, which come to a point distally, and are not rounded; the neural canals and vertebrarterial canals are small; the excavation of the neural arch posterior to the prezygapophysis is shallow (from the eighth cervical posteriorly in *Casuarius* the excavation of the neural arch is deep); the thoracic vertebrae are similar to those of *Casuarius*, but the neural canals are smaller; the neural canals of the caudal vertebrae are small, with an elliptical cross-section, whereas in *Casuarius* the neural canals are large and triangular in cross-section; the sternum is only slightly longer than wide, not much longer than wide as in *Casuarius*; the costal processes lie in an almost horizontal plane, whereas in *Casuarius* they lie on a downward curve (antero-posteriorly); the sterno-coracoidal processes are moderately long, not very short as in *Casuarius*; the coracoidal sulci are short and overlap medially, whereas they are long and do not overlap in *Casuarius*; the body of the sternum is weakly concave dorsally, but in *Casuarius* it is strongly concave dorsally; the depth of the sternum anteriorly is shallow, not deep; the costal margin is long, whereas in *Casuarius* it is shorter; the supratrochanteric ridge is broader; the pre-acetabular synsacrum tends to be shorter than the post-acetabular synsacrum in *Dromaius* while the opposite condition exists in *Casuarius*; proximally and posteriorly the femur bears a large pneumatic foramen, lacking in *Casuarius*; in anterior view, the external condyle extends decidedly further proximally than the internal condyle, while the two condyles are subequal in anterior proximal extent in *Casuarius*; in medial view, the internal condyle is semicircular in outline, while in *Casuarius* it is triangular; the diameter of the head and the minimum diameter of the shaft at its proximo-distal mid-point are equal, whereas in *Casuarius* the head diameter is less than the shaft diameter; the shaft is almost straight, being more curved in *Casuarius*; the proximal extent of the cnemial crest is not as great as in *Casuarius*; anteriorly the external

condyle is rounded proximally, and it extends further proximally and is more pointed in *Casuarius*; above the anterior intercondylar fossa is a small ridge trending dorsally and laterally from the mid-line and ending in a small foramen, while in *Casuarius* this ridge is absent, but the foramen still exists; the tarsometatarsus and tibiotarsus are subequal in length, unlike in *Casuarius* in which the tarsometatarsus is decidedly shorter; the second trochlea is much more reduced than in *Casuarius*; the intercotylar prominence is low and tends to be flat, while in *Casuarius* the intercotylar prominence is higher and convex dorsally; a distal foramen, which completely penetrates the tarsometatarsus (antero-posteriorly), and a groove (occasionally a completely roofed-over foramen) running proximo-distally, are present, both absent in *Casuarius*; the condyles of the phalanges of the foot tend to be greatly divergent plantarly; in *Casuarius* the condyles tend to be only moderately divergent plantarly; in distal view, the intercondylar fossa tends to be only slightly notched in a step-shaped fashion dorsally, while in *Casuarius* this notch tends to be deeper and more V-shaped; the ungual of digit III is longest, and that of digit IV shortest, while in *Casuarius* the ungual of digit II is longest, and that of digit IV shortest.

Dromaius novaehollandiae (Latham)

Type

Casuarius novaehollandiae (Latham)

Type Locality

New Holland (Sydney, New South Wales, Australia) (Table 1).

Measurements

Tables 2-13.

Referred Fossil Material

Bingara, New South Wales — *V.*, MM F16786, dorsal vertebra (*V.*24-26?), neural spine, pre- and postzygapophyses, diapophyses and prearticular surface damaged; MM F16797, dorsal vertebra (*V.*24-26?), neural spine and diapophyses not preserved. *Tib.*, MM F16775, distal end and distal half of shaft. Pleistocene.

Bone Cave (near Jewel Cave), Western Australia — *Tib.*, WAM 68.5.34 (in part), shaft only. *Tmt.*, WAM 68.5.34 (in part), shaft only. Quaternary.

Brothers Island, South Australia — *F.*, SAM P17104, proximal end and proximal two-thirds of shaft, head and trochanter damaged. Quaternary.

Chinchilla, Queensland — *Tmt.*, QM F1143 (in part), third trochlea only.

Cooper Creek, South Australia — *Syn.*, UCMP 56333, acetabular complex, (site 2, UCMP V5378). *F.*, HM B775/869, entire, (Lower Cooper, locality 3). *Tmt.*, UCMP 56313, distal end, fourth trochlea not preserved, (site 3, UCMP V5379). Late Pliocene or Early Pleistocene.

Darling Downs, Queensland — *F.*, QM F1143 (in part), distal, popliteal fossa region only (eastern Darling Downs). *Tib.*, AM A9713, proximal, see Figure 1; QM F5547, proximal, figured (De Vis 1889); QM F5548, distal, figured (De Vis 1889); QM F1652, proximal end, most of cnemial crests not preserved, (Condamine River, near Dalby). *Tmt.*, QM F1121, proximal frag.; QM F1135, figured (De Vis, 1892), distal, juvenile; QM F1142, distal frag.; QM F1143 (in part), distal end (eastern Darling Downs). Pleistocene.

Lake Callabonna, South Australia — AMNH 9678. *V.*, second cervical, posterior left side; third cervical, left side; fourth cervical (articulates with third cervical), neural spine and ribs not preserved; sixth cervical?, ribs and right side postarticular surface not preserved; seventh cervical?, (articulates with sixth cervical), ribs and right side prezygapophysis not preserved; ninth cervical?, postarticular surface, ribs, right side postzygapophysis not preserved. SIAM 61. *St.*, fragments. AMNH 9677. *F.*, distal end, internal condyle damaged. AMNH 9676. *Tib.*, entire, see Figure 2. Pleistocene.

Lake Kanunka, South Australia — *V.*, UCMP 56855, dorsal vertebra (*V.*22 or 23), (UCMP 5772). *F.*, UCMP RHT1064, trochanter, condyles, and head partly eroded and crushed, (site 1, UCMP V5772). *Tib.*, UCMP 56845, distal end, most of internal condyle not preserved and remainder highly eroded (UCMP V5772). *Ph.*, UCMP 56849, first phalanx, second digit, (UCMP V5772); UCMP 94679, first phalanx, third digit; UCMP 94680, second phalanx, third digit (UCMP V5772). Late Pliocene or Early Pleistocene.

Lake Menindee, New South Wales — *Eggshell*, UCMP 55948. *Tib.*, UCMP 53825, two distal tibiotarsi with the same number. *Tmt.*, UCMP 53835, distal end most of third trochlea and second and fourth trochleae not preserved. *Ph.*, UCMP 53832, dark colour (presumably burnt), first phalanx, second digit, distal end; ungual phalanx, second or fourth digit; first phalanx, second digit, proximal end; second phalanx, fourth digit (UCMP V5371), UCMP 53833, first phalanx, fourth digit and ungual (site II, V67185); UCMP 55983, first and second phalanges, third digit (UCMP V67186). Late Pleistocene.

Lancefield, Victoria — *Tib.*, NMV P43037, distal shaft; NMV P43041, distal shaft, juvenile; NMV P44011, entire but articular surface worn; NMV P150013, distal. *Tmt.*, NMV L5, distal; NMV P44012, proximal articular surface eroded; NMV P44013, hypotarsus eroded; NMV P44014; NMV P44015, proximal articular surface worn, second and fourth trochleae not preserved; NMV P44016,

proximal articular surface worn; NMV P44017, distal shaft; NMV P44018, distal; NMV P44019, distal; NMV P48392, second and part of third trochleae not preserved; NMV P150014, distal, fourth trochlea not preserved. *Ph.*, NMV P43199, first phalanx, third digit, articular surfaces worn; NMV P43200, second phalanx, third digit, proximal end. Late Pleistocene, 26 000 B.P.

McEachern's Cave, Victoria — *C.*, NMV P157345, posterior fragment; NMV P157350, lower jaw, distal; NMV P157353, posterior fragment. *V.*, NMV P157346, 21st or 22nd vertebra, neural spine, diapophysis, right side prezygapophysis, part of centrum and prearticular surface not preserved; NMV P175349, 23rd or 24th vertebra, neural spine, pre- and postzygapophyses not preserved, postarticular surface worn; NMV P157351, seventh cervical?, juvenile, ribs not ankylosed; NMV P157352, 11th, 12th or 13th cervical, juvenile; NMV P157359, third cervical, right side rib not preserved; NMV P157364, 25th or 26th vertebra, left side of centrum with prezygapophysis and diapophysis, but postarticular surface not preserved; NMV P157367, 20th or 21st vertebra, diapophysis, part of neural arch, postzygapophyses, and right side prezygapophysis only, juvenile; NMV P157368, about 11th cervical, prearticular surface worn, left side prezygapophysis and ribs (not ankylosed) not preserved, juvenile; NMV P157369, 22nd to 26th vertebra, right side of centrum only, juvenile. *St.*, NMV P157347, incomplete; NMV P157355, entire. *Syn.*, NMV P157361, fragment. *Tib.*, NMV P157356, proximal; NMV P157357, distal; NMV P157360, distal; NMV P157365, proximal. *Fib.*, NMV P157363, proximal end. *Tmt.*, NMV P157344, distal, trochleae not preserved. Quaternary.

Cave north of Moore River, Western Australia — *Tmt.*, WAM-190 unregistered, (not seen, data from Pat Rich's 1971 field notes). Quaternary.

Naracoorte, (Henschke's Bone Dig and Victoria Fossil Cave), South Australia — *C.*, SAM P17834, lower jaw, distal end only, (Henschke's A3, 40″). *V.*, SAM P17589, 16th cervical, ribs not preserved; SAM P18246, fourth cervical; SAM P18247, 22nd to 24th vertebra, part of centrum and left side diapophysis, (Henschke's); SAM P18673, 15th to 17th cervical? vertebra, prezygapophyses and centrum damaged, (Henschke's area X4, depth 17″); SAM P18830, 26th vertebra, prezygapophyses, prearticular surface and diapophyses damaged, (Henschke's area X6, 15–30 cm). *Syn.*, unregistered SAM; SAM P16501, acetabular complex only, (Victoria Fossil Cave, 0-10-R10-0-12″), see Figure 3; SAM P17767, parts of ilium, ischia and pubes not preserved, (Henschke's A3, 39–42″); SAM P18100, distal right ischium only, (Henschke's A1, 33–36″). *F.*, SAM P22812 (in part), condyles badly eroded; unregistered SAM, internal condyle damaged. *Tib.*, SAM P17149, distal end, internal condyle worn; SAM P18829, distal, part of condyles not preserved, (Henschke's area X6, 0–15 cm). *Tmt.*, SAM P17816, distal, (Henschke's A1, 30–33″); SAM P18693, 2 pieces, proximal, with articular surface badly eroded, and distal (Henschke's area A4, 150 cm, western wall). *Ph.*, SAM P18059, first phalanx, second digit (Henschke's area A3, 33–36″); SAM P18248, second phalanx, third digit, (Henschke's); SAM P18249, first phalanx, fourth digit, (Henschke's); SAM P18252, first phalanx, fourth digit, (Henschke's). Pleistocene.

Salt Creek, South Australia — *F.*, SAM P17101, proximal shaft only, but head and part of trochanter not preserved. Quaternary.

Thorlindah, (Paroo River), Queensland — *Tib.*, MMF 12074, figured (Etheridge 1889), a cast (AM L516) has been made, distal end, condyles worn. Pleistocene.

Trogdip Cave, Buchan Caves, Victoria — *Tmt.*, NMV P157343, shaft only. Pleistocene.

Warburton River, South Australia — *V.*, UCMP 56642, 21st or 22nd vertebra, centrum only (Green Bluff locality, UCMP V-5775). *Syn.*, UCMP 56647, fragment, fused sacral vertebrae only. *F.*, HM B801/934, distal, most of internal condyle not preserved, (Kalamurina), see Figure 4. *Tmt.*, SAM P13118, distal end, second trochlea not preserved. (Stony crossing of Warburton. Six road miles west of new Kalamurina Station.) Quaternary.

Wellington Caves, New South Wales — *Tib.*, AM 'B', distal end, external condyle missing; AM F10949, distal half, (J. Mahoney, in a note on the back of the museum label, disputes this locality). *Tmt.*, unregistered AM, proximal articular surface badly worn; AM 'C', proximal; AM F18935, distal end and part of shaft, second trochlea not preserved, other trochlea pitted, no distal foramen, juvenile; AM MF771, distal. Quaternary.

Wombeyan Quarry, New South Wales — *Tib.*, AM P58025, distal end and distal one-third of shaft. *Tmt.*, AM P58026, proximal. Late Pleistocene.

Comments and Description

Dromaius novaehollandiae is the only extant species. A number of subspecies have been suggested (Condon 1975), but little is known of their ranges or morphological distinctness. The osteological characteristics of the species have been described above. There is a suggestion that a slightly smaller, as well as a larger form of *Dromaius novaehollandiae* existed during the Pleistocene. The name *gracilipes* proposed by De Vis for the smaller form was applied to a juvenile *D. novaehollandiae* (see below). Hence the smaller form, if real, is yet unnamed. As the evidence is limited, we have chosen not to create a separate specific or subspecific names. De Vis also described a larger

species of emu, *D. patricius*, which we have also synonymized with *D. novaehollandiae* (see below).

Dromaius patricius (De Vis)

Lectotype (here designated)

QM F5547, proximal right tibiotarsus, King Creek, Darling Downs, south-eastern Queensland, Pleistocene.

Measurements

Tables 9 and 11.

Referred Material

De Vis assigned a coracoid, and a proximal and a distal tibiotarsus to this species without naming a type specimen. The left coracoid, QM F1120, was only provisionally referred to *patricius* (De Vis 1888: 1291). In actual fact it is not even a bird bone. The bone is not hollow, and it projects too far lateral to the point taken by De Vis for the glenoid facet to conform with an emu coracoid. Additionally, it lacks a pneumatic foramen. It is too large, heavy, and robust to match any bird. It is probably part of a mammalian pelvis.

The distal end of the left (not right as De Vis states) tibiotarsus, QM F5548, which De Vis assigned to *D. patricius* is not distinguishable from *D. novaehollandiae*. De Vis also stated (p. 1290) that: 'the rotular surface is relatively longer fore and aft to a considerable extent and less concave transversely', but he admitted (p. 1291) that this: 'is perhaps in some measure due to abrasion'. The difference in the 'eminences and ridges for muscle insertions' anteriorly are also as De Vis states (p. 1291): 'scarcely of specific value'. This specimen is within the size range of *D. novaehollandiae*.

Hence we designate the proximal right tibiotarsus, QM F5547, as the lectotype of *Dromaius patricius*. It is in most respects trivially different, if at all from *D. novaehollandiae*. The proximal width (of the articular surface) *is* greater than any *D. novaehollandiae* in our sample (57.6 mm vs a maximum of 55.6 mm for *novaehollandiae*, sample size, n=9). The inner cnemial crest (>90.2 mm) is unfortunately not entirely preserved. It may have exceeded the maximum of our sample of *D. novaehollandiae* (103.1 mm). Concerning other points raised by De Vis, the fibular crest does not attach more proximally, but the bone is thicker at the most proximal point of this crest, the external cnemial crest does descend more distally and a groove between the external and internal cnemial crests does exist that is larger than is present in *D. novaehollandiae*. We feel that the variability exhibited by *D. patricius* would not fall outside that of a large sample of the living emu.

De Vis (1905) also referred a synsacral fragment (consisting of the neural canal of several synsacral vertebrae), QM F5549, to *D. patricius*, though it is so incomplete as to render diagnosis difficult. It is within the size range of *D. novaehollandiae* and probably could be referred to that species. We have, however, chosen to assign it only to Casuariidae indeterminate. It was collected from Wurdulu-mankula, a Cooper Creek locality.

De Vis (1892) referred a part of a distal end of a femur (likely to be QM F1143, in part), the proximal third of a tarsometatarsus (likely QM F1121), the 'calcaneal region of another metatarse' (apparently lost subsequently) and a distal tarsometatarsus (likely QM F1143 in part) to *D. patricius*. As De Vis did not figure or describe these specimens in any detail, we are assuming that the QM specimens listed are those referred to in his 1892 paper. They agree with the (limited) description, were collected in the Darling Downs according to the museum labels accompanying the specimens, and appear to bear (on the fossils themselves) De Vis' handwriting. Of these, only the distal tarsometatarsus is described. It is stated to be larger in almost all of its dimensions than the living Emu. It is, indeed, wider than any in our small sample both in the shaft and in its trochlear expansion, and trochlea 3 is deeper than those in our sample of *D. novaehollandiae*. The proximal tarsometatarsus is very worn: it lacks both the internal and external cotyla, the intercotylar region, and the hypotarsus. It is within the size range of the living *D. novaehollandiae*. The femur is also very fragmentary; only the popliteal region is preserved, and it, too, lies within the range of *D. novaehollandiae*.

Etheridge (1889) referred a distal right tibiotarsus, MM F12074 (and cast AM L516) to *D. patricius*, but contrary to his assertion, the specimen is not larger than nor of a different shape to that element in the modern emu. It should be referred to *D. novaehollandiae*.

Thus, some of the specimens that have been considered to be *D. patricius* are indistinguishable from *D. novaehollandiae*. Others may be slightly larger in some measurements, but we doubt that *D. patricius* deserves, on that account, specific status, because our sample of the living emu is still small. We, therefore, synonymize *D. patricius* with *D. novaehollandiae*.

Dromaius gracilipes (De Vis)

Holotype

Tmt. QM F1142, Darling Downs, Queensland, Pleistocene.

Measurements

Tables 10 and 11.

Description

De Vis based this species on a distal left tarsometatarsus, QM F1142, with the second and

fourth trochleae not preserved and the margins of the third trochlea very eroded. The characteristics which De Vis used to distinguish this from *D. novaehollandiae* are the lack of a distal foramen and associated muscle canal, inferior size of the distal end, antero-posterior compression of the shaft, and disproportionate size of the mesial trochlea. These are all juvenile characteristics. De Vis also states that the width of the third trochlea taken from centre of the lateral depressions (i.e. the ligamental pits) is greater in *D. gracilipes* than in *D. novaehollandiae*. This is not the case. We therefore synonymize *D. gracilipes* with *D. novaehollandiae*.

Metapteryx bifrons (De Vis)

Type

Tmt. QM F1135, locality not given, but presumably Darling Downs, Queensland, Pleistocene.

Measurements

Table 11.

Description

De Vis erected this genus and species on the basis of a left distal tarsometatarsus, QM F1135, and allied it with the kiwis because: 'the trochlea appear to be borne on the ends of moderately long stalks' (De Vis 1892: 449), the lateral trochlear processes (i.e. the second and fourth trochleae) are almost equal in length, the medial trochlea extends beyond the others, the posterior surface of the shaft shows the lines of junction between the coalesced segments, and it lacks a distal foramen which perforates the shaft. De Vis considered the possibility that these might be juvenile characteristics, but unfortunately dismissed this idea. De Vis was of the opinion that the fourth trochlea was shorter (that it was a right tarsometatarsus), but actually the second trochlea is shorter. The comparatively large intertrochlear notches, the rough pitted caps on the trochleae, and the points raised by De Vis (presence of epiphyseal lines, lack of distal foramen) are indications that the specimen is of a juvenile bird. As De Vis himself noted, the fossil does not have any articulation for the hallux possessed by kiwis, and the middle trochlea is too large for that of a kiwi. *Metapteryx bifrons* in all respects conforms to a juvenile individual of *D. novaehollandiae*, and we synonymize it with that species.

Dromaius ocypus (Miller)

Holotype

Tmt. SAM P13444, Lawson-Daily Quarry, Lake Palankarinna, eastern Lake Eyre Basin, South Australia, Mampuwordu Sands, Palankarinna fauna, Pliocene.

Measurements

Tables 8, 9, 10 and 11.

Referred Material

F. UCMP RAS5176, condyles, trochanter, and most of head not preserved. *Tib.* UCMP RAS5182, distal. Same locality as type.

Description

Miller (1963) established this species from an essentially complete, but somewhat distorted and cracked right tarsometatarsus, SAM P13444. The overall length, width across the distal end, depth across the internal cotyla and proximal width are all less than similar measurements in living and fossil *D. novaehollandiae*. Additionally, the curvature of the intercotylar region is more pronounced (convex dorsally) than in *D. novaehollandiae*. As noted by Miller (1963), the trochleae have already attained the size and proportions of *D. novaehollandiae*. The width across the distal end is smaller, in part because the intertrochlear notches are narrower than in *D. novaehollandiae*.

The femur and tibiotarsus are provisionally assigned to *D. ocypus*, although they lie within the range of *D. novaehollandiae* in those parts which are preserved, because they were found in the locality of the type specimen. The tarsometatarsus of *D. ocypus* differs most noticeably from *D. novaehollandiae* in its shortness. Unfortunately, the referred specimens are incomplete, and their length cannot be ascertained.

Dromaius gidju n. sp.

Holotype

SAM P26779. Associated left leg elements.

Type locality

Leaf locality (UCMP V6213), Lake Ngapakaldi, eastern Lake Eyre Basin, South Australia, Wipajiri Fm. Kutjamarpu fauna. Medial Miocene.

Description

An incomplete left leg, consisting of the distal fragment of the tibiotarsus (originally UCMP 71397), the proximal part of the tarsometatarsus (originally UCMP 71398), and a complete pes (originally UCMP RAS5234). The tibiotarsal fragment articulates with the tarsometatarsal fragment. The pes is complete but does not articulate with the tarsometatarsal fragment as the trochleae of the tarsometatarsus are not preserved. All fragments were found in close proximity and the assumption is made here that they are from one individual. Dr R.A. Stirton in his field notes of 19 July 1962 assumed that the leg and foot elements were all from one individual and assigned them a single field number RAS 5234.

Etymology

From an Aboriginal word meaning 'small' (Anonymous 1965, language not specified).

Measurements

Tables 9, 10 and 12.

Referred material

None.

Diagnosis

A small emu with a slender antero-posteriorly compressed tibiotarsus and tarsometatarsus. The anterior lip of the intercotylar region is convex dorsally in *D. gidju* (as in *D. ocypus* compared to nearly flat in *D. novaehollandiae*). The intercotylar region does not extend far proximal to the articular surface as it does in *Casuarius*, however. The lateral lip of the external cotyla is noticeably convex laterally in *D. gidju* (weakly so in *D. novaehollandiae*). The width and depth of the proximal articular surface are much less than in *D. ocypus* and *D. novaehollandiae*. The *D. gidju* tibiotarsus is much smaller than those in our *D. novaehollandiae* sample, but is similar in general appearance and proportions of the distal end. Anteriorly the tarsometatarsus proximal to the condyles is somewhat crushed. The external ligamental prominence above the external ligamental pit is not as well defined in *D. gidju* as it is in *D. novaehollandiae*. The anterior ligamental fossa appears proportionally larger and deeper than in *D. novaehollandiae*. The phalanges (except the second phalanx of the second digit) are smaller than those in *D. novaehollandiae*. Digit II is comparatively longer relative to the other digits than in *D. novaehollandiae* (64% of the length of digit III versus 57.5–60.5% for our sample of *D. novaehollandiae* (see Tables 2 and 12); the first phalanx of digit II is 85% of the proximal depth of the first phalanx of digit III versus 76.5–78% for our sample of *D. novaehollandiae*, and 66% of the proximal width of digit III versus 52–53% for our sample of *D. novaehollandiae*). Digit IV is also comparatively longer but less change has occurred (68% of the length of digit III versus 62–64% for our sample of *D. novaehollandiae*, the first phalanx of digit IV is 78% of the depth of the first phalanx digit III versus 73–75% in our sample of *D. novaehollandiae*). Excepting the proximal phalanges, the ratio of maximum proximal depth to width is greater in *D. gidju*; thus, the phalanges of *D. novaehollandiae* are more dorso-ventrally compressed than in *D. gidju*. The ungual phalanx of digit II in *D. gidju* is longer than the ungual of digit III (which is poorly preserved). This is not due to an elongation of the ungual of digit II in *D. gidju*, as in *Casuarius*, but the weak development of the digit III ungual.

Comment

From what is known of its hind limb structure, it would appear that *D. gidju* was less cursorially adapted than *D. novaehollandiae*. This is based on the greater length of digits II and IV relative to digit III in *D. gidju* as compared to *D. novaehollandiae*. This foot structure is presumably adapted for greater maneuverability in forested or less open conditions and greater ability to move over regions of a somewhat unpredictable nature.

Dromaius sp. indet.

Several specimens because of their fragmentary nature and/or unusual proportions could not be assigned to species level. Other specimens were referrable only to Casuariidae indet. (see following section).

Referred Material

Tables 3–12.

No Locality Data — *Tmt.*, AM F58087, distal end, trochleae not preserved.

Alcoota, Northern Territory — *Tmt.*, QM QA205, third trochlea only; QM QA505, distal, fourth trochlea not preserved. UCMP RAS5397 (in part), a third trochlea only. *Ph.*, QM QA504, first phalanx, third digit; UCMP RAS 5397 (in part), second phalanx, second digit. The Alcoota specimens are close to *D. gidju*. Late Miocene.

Baldina Creek? (near Burra), South Australia — *F.*, SAM P17103, shaft only, partially reconstituted in plaster. Quaternary.

Cooper Creek, South Australia — *Tmt.*, QM F1121, proximal, badly eroded articular surface. Could be Pliocene-Recent in age.

Lancefield, Victoria — *Tmt.*, NMV P35578, distal shaft. Pleistocene in age, dated at about 26 000 B.P. (Gillespie *et al.* 1978).

Warburton River, South Australia — *Tib.*, QM F6668, distal, condyles not preserved, ('Kalamurina?' is pencilled on the bone). *Tmt.*, QM F6671, proximal, incomplete fusion of metatarsals dorsally, tarsal cap not preserved, juvenile. Pleistocene-Recent in age.

Wellington Caves, New South Wales — *St.*, AM F25218, figured (Anderson, 1934), incomplete. *Tmt.*, AM 'A' distal, trochleae not preserved; AM F10850 (cf. *D. novaehollandiae*), proximal end plus proximal part of shaft, articular surface eroded. Pleistocene.

Dromaiinae indet.

Referred Material

Tables 3–12.

No Location Data — *Syn.*, QM F6673, fragment, fused vertebrae only.

Bingara, New South Wales — *Syn.*, MM F16795, fused vertebrae only. Pleistocene.

Cooper Creek, South Australia — *V.*, HM B776, dorsal vertebra, 24th–26th?, centrum and left postzygapophysis only, (Lower Cooper, locality 2). *F.*, HM B777, part of a left internal condyle and internal popliteal fossa region only; UCMP 60532, popliteal fossa region only, (Katipiri Waterhole, UCMP site 9, V-5861). The locality suggests all specimens are *Dromaius* sp. Pleistocene.

Lake Kanunka, South Australia — *V.* r, UCMP 60560, third or fourth vertebrae?, proximal (dorsal) only, (Site 1, UCMP V-5772). Probably *Dromaius*; other *Dromaius* elements known here. Probably Late Pliocene, possibly Pleistocene.

Lake Kittakittaooloo, South Australia — *Tmt.*, SIAM 75, fourth trochlea only, pitted, juvenile. Late Pliocene, possibly Pleistocene.

McEachern's Cave, Victoria — *V.* r, NMV P157354, dorsal fragment; NMV P157358, dorsal fragment; NMV P157362, dorsal fragment; NMV P157366, dorsal fragment, one facet not preserved. Probably *Dromaius*. Quaternary.

Naracoorte, South Australia — *V.* r, SAM P18107, third vertebrae?, dorsal fragment, (Henschke's Bone Dig); SAM P18251, dorsal fragment only but facets not preserved, (Henschke's Bone Dig); SAM P18784, third vertebrae?, dorsal fragment (Henschke's Bone Dig); SAM P22812 (in part), third or fourth vertebrae?, dorsal fragment. The locality suggests these specimens are *Dromaius*. Quaternary, probably Late Pleistocene.

Warburton River, South Australia — *Syn.*, UCMP 56647, acetabulum and pectineal process only. Quaternary.

Wombeyan Quarry, New South Wales — *Tib.*, AM P58027, cf. *Dromaius*, distal end. Late Pleistocene.

Aves indet.
(previously assigned to *Dromaius*)

Referred Material
Tables 10 and 11.

Kalamurina, South Australia — *Tmt.*, SAM P11552, distal end, second trochlea not preserved, large. Perhaps Dromornithidae (Table 11). Quaternary.

No Locality Data — *Tib.*, SAM P17148, proximal shaft only, articular surface and cnemial crests not preserved. Possibly not avian — the bone is rather dense.

Dromaius ater and *D. baudinianus* are not reviewed here as Parker (1984) has recently revised their taxonomy.

Discussion

At least one species of emu, *D. gidju*, was present in central Australia in the mid-Miocene. It is known from the Lake Ngapakaldi in northern South Australia and associated with the Kutjamarpu fauna. It does not differ sufficiently from other emus to require erection of a new genus. While the intercotylar region of the fossil tarsometatarsus resembles the condition found in *Casuarius* in that is is not markedly flattened as in the living *Dromaius*, this character state is also true of *D. ocypus*, an undoubted emu from the Pliocene. The shape of the margin of the internal cotyla of the fossil is similar to that of *Dromaius* and dissimilar to that of *Casuarius*, which is more excavated posteriorly. The posterior surface of the tarsometatarsus of *D. gidju* is unfortunately chipped and cracked, but the shape of the remaining fragment of the hypotarsus and tarsal cap appears more emu-like than cassowary-like. Comparing the pes of the Miocene fossil with recent emus it is obvious that the foot structure has undergone change through the last few million years. The second and, to a lesser extent, the fourth toes have undergone a reduction in size. This trend is parallel with several other ratites (the ostrich and some of the Dromornithidae; Rich 1979), and would appear to be a cursorial adaptation similar to the reduction and eventual loss of lateral and medial digits within horses (Equidae). The pes of *D. gigju* is more cassowary-like than that of any known living or other fossil emus, implying that in the Miocene, emus were not as highly adapted to an open plains, cursorial lifestyle as they are now. The pes does not, however, contain the specialized ungual spike on digit II, which so characterizes the cassowaries. *D. gigju* appears to be a species that may be close to forms which gave rise to both emus and cassowaries. Based on material now available, *D. gidju* has a few specialized characteristics that seem to ally it with *Dromaius*. But, as our records of this form increase, there may be sufficient reason to separate it from both genera within this family as an early, quite unspecialized form.

A small emu of Miocene age, is also known from Riversleigh, Queensland. This material is currently under study by Walter Boles (Australian Museum). By Late Miocene or Early Pliocene times a species near in size to *D. gidju* is known in the Alcoota fauna. It is represented by tarsometatarsal and pedal fragments. This form may be referrable to *D. gidju*. The two phalanges differ slightly from those of the Lake Ngapakaldi form, which we have referred to *D. gidju*, but are within the range expected for intraspecific variation. Until more complete material is available from Alcoota, however, assignment to *Dromaius* sp. indet. is preferable. It

is certainly not referrable to *Casuarius*, as the second trochlea is much more reduced relative to the other trochleae, similar to the condition in *Dromaius*.

By mid-Pliocene, a second species of emu, *D. ocypus* Miller, intermediate in size between *D. gidju* and *D. novaehollandiae*, existed. It is known from a right tarsometatarsus and part of a femur and tibiotarsus. The femur and tibiotarsus are, in those parts which are preserved, not unlike *D. novaehollandiae*, but if complete would probably be shorter than the corresponding elements in *D. novaehollandiae*.

In any event, *D. novaehollandiae* existed by the Late Pliocene or Early Pleistocene. Since then only *D. novaehollandiae* has been present on the mainland. It has probably fluctuated slightly in size, presumably as a result of a host of selection pressures such as climate (both temperature and rainfall), diet, predation pressure and competition.

The species restricted in Recent times to King Island and now extinct may possibly extend into the Pleistocene. Localities on King Island are as yet not carefully dated. The emus of King Island (*D. minor*) and Kangaroo Island (*D. baudinianus*) appear to be separate species (Parker 1984). The populations on both of these are most likely relics isolated by rising sea levels at the end of the last glaciation of a population that perhaps was once more widespread. Other than their smaller size the King and Kangaroo Island emus differ but little from the mainland emu. The main osteological difference is in the shape of the skull (Spencer & Kershaw 1910, Morgan & Sutton 1928). Possibly also the distal foramen of the tarsometatarsus differs (Shane Parker pers. comm.), but there is considerable variability in this character in the mainland emu. The degree to which the groove for the musculus adductor digiti IV is roofed over by bone would appear to be age related. In juvenile emus the arch is almost completely lacking, whereas in some adult specimens it is completely formed in bone. Thus, this character is not taxonomically significant for emus. Some Australian mainland fossil emus are within or just larger than the size range for *D. minor* tabulated in Rich (1979). At Lake Menindee, two distal tibiotarsi (UCMP 53825, includes RHT6 and RHT25) lie within the range of *D. minor* for the width across the condyles and depth of external condyle but exceed *D. minor* in the depth of the internal condyle — both specimens measure 37.0 mm in depth of the internal condyle; the range of a sample of 50 *D. minor* was 26.2–36.1 mm, the mean was 30.4 (Rich 1979, Table 33). What the relationship of these fossils is to *D. minor* is unresolved and will remain so until a much larger fossil sample of mainland birds is at hand.

De Vis (1892) did describe a smaller mainland Pleistocene species, *D. gracilipes*, but his type specimen is undoubtedly an immature *D. novaehollandiae*. Nevertheless, smaller emus did exist in Australia in the Pleistocene. Of specimens listed in the systematics section (above) the following lie below the range for modern emus in one or more measurements: AM — unregistered tarsometatarsus, 'A', F10949, MF771; HM B775/869; QM F1121; SAM — P13118, P18099; UCMP — 53825, 53832, 55983, 60532, 79510, RHT1064.

The presently known fossils of mainland emus smaller than the living *D. novaehollandiae* are unfortunately few. We do not believe that they are representatives of *D. minor* or *D. baudinianus*, because of the age of the fossils on the islands is Late Quaternary. We favour the idea that speciation on King and Kangaroo Island could have taken place in very little time geologically speaking. Strong selection for dwarfism quite likely occurred after these emus became isolated at the beginning of the last interglacial (i.e. the Holocene).

The mainland emu, *D. novaehollandiae*, may have been at any one time in the Pleistocene both larger or smaller than at present. However, there is a possibility that the differences seen in fossil samples are more apparent than real, since the sample size of modern emus is still fairly small and some of the emus in osteological collections were recovered from zoological gardens. Whether or not extant wild emu populations differed significantly in size is largely unknown. As our sample did not contain representatives from the Northern Territory or Western Australia, it is also unavoidably biased geographically.

Periodic dwarfing of the mainland form may have been caused by the same selective agents which produced dwarfing in the island forms. We were unable to test the hypothesis that size changes were related to palaeoclimate or other environmental variables because there are too few reliably dated emu specimens in the Quaternary collections.

De Vis recognized *D. patricius* as a separate, larger species of emu, but we can see no significant size difference from *D. novaehollandiae*. Perhaps *D. patricius* differed in its proportions from *D. novaehollandiae*. As so few complete bones are known, however, this is difficult to assess. For example, a tibiotarsus SIAM 61 was found to have a smaller length to distal width ratio than most modern emus, but this difference did not prove statistically significant ($p > 0.05$, t-test).

There was a mass extinction of the Australian megafauna [the larger macropodids, diprotodontids, dromornithids, etc. just before the Holocene (Tedford 1967, Gillespie *et al.* 1978)] suggesting a widely acting selective agent against large size.

There is a suggestion that the Tasmanian emu,

D. diemenensis, averaged slightly smaller than the mainland form. This idea stemmed from the known eggs of the Tasmanian emu measuring slightly smaller than those of the mainland emu (Dove 1926), and from the recollections of Legge (1907), who saw the Tasmanian emu as a boy. On the other hand, Spencer & Kershaw (1910) report that the Rev. Knopwood captured an 'Emew 60 lbs. weight' on 9 October 1804 in Tasmania. Scott (1924) gives the dimensions of a leg of the Tasmanian emu collected by Gunn in the 19th century; it is as large as those of the mainland. The fossils of the Tasmanian emu are large (Scott, 1924, 1932) indicating that the larger Pleistocene form of the mainland also reached Tasmania, presumably at a time when Bass Strait did not exist — during a glacial period of lowered sealevel. Concerning the extinct Recent Tasmanian emu, the best evidence supports the view that it was about the same size as the mainland emu. Condon (1975), following Ridpath & Moreau (1966), treated the Tasmanian emu as a subspecies of *D. novaehollandiae*. Kathryn Medlock (Tasmanian Museum) is currently reviewing the status of this form.

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TABLE 2. Statistical summaries of the extant emu *Dromaius novaehollandiae* ($\bar{x}$, mean; s, standard deviation; n, sample size).

	Range (mm)	$\bar{x}$	s	n
Skull				
Length	140 –165	154	6.3	16
Width	58.7– 76.5	68.4	4.1	21
Depth	44.7– 50.7	48.0	1.6	19
Diameter of Foramen Magnum	9.3– 13.1	11.0	1.0	25
Length of Lower Jaw	131 –155	145	6.5	21
Symphysial Length of Lower Jaw	16.4– 23.0	21.0	2.4	23
Sternum				
Maximum Length	114 –164	143	11.4	25
Maximum Width	104 –141	125	8.2	25
Number of Costal Processes	3 – 5	4	0.49	28
Width of First Costal Process	98.7–134	116	8.2	24
Width of Last Costal Process	76.4–112 5	96.8	8.2	24
Length of Costal Margin	42.4– 66.9	56.0	7.2	24
Length of Sternocoracoidal Process	16.3– 44.7	33.3	8.2	24
Width of Coracoidal Sulci	40.2– 62.2	51.9	5.9	24
Anterior Depth	14.4– 20.4	16.7	2.0	23
Scapulocoracoid				
Proximal Width	38.9– 55.6	45.9	4.9	20
Maximum Length	151 –187	168	11.3	18
Scapular Length	98.4–127	114	8.7	18
Minimum Width of Coracoid	13.1– 22.0	16.1	2.2	20
Minimum Width of Scapula	5.9– 8.9	7.3	1.0	19
Clavicles				
Length	35.2– 53.3	44.0	5.1	12
Maximum Width	3.6– 8.1	5.5	1.2	12
Depth	2.0– 4.9	3.4	0.8	12
Humerus				
Length	83.1– 98.7	90.3	4.2	20
Proximal Width	5.4– 8.3	6.4	0.8	20
Proximal Depth	6.2– 7.9	6.9	0.5	20
Ulna				
Length	57.5– 73.0	64.9	4.5	20
Proximal Width	3.6– 4.8	4.2	0.3	20
Proximal Depth	3.3– 4.8	4.0	0.4	20
Radius				
Length	55.2– 68.9	63.1	4.1	20
Carpometacarpus				
Length	36.6– 50.6	43.6	3.6	20
Proximal Width	7.7– 12.3	10.0	1.2	20
Proximal Depth	4.6– 6.5	5.5	0.5	20
Distal Depth	2.5– 4.4	3.4	0.5	19
Manus				
P1, Length	10.0– 26.6	13.6	4.1	13
P1, Proximal Diameter	4.2– 6.9	5.0	0.8	11
P2, Length	4.8– 8.0	6.3	1.4	5
P2, Proximal Diameter	1.9– 3.7	3.0	0.7	5
P3, Length	6.1– 14.9	10.4	2.7	6
P3, Proximal Diameter	14.0– 5.2	2.8	1.3	6

	Range (mm)	$\bar{x}$	s	n
Synsacrum				
Length	337 -412	378	24.7	17
Diameter of Acetabular Foramen	12.3- 21.0	17.3	2.3	23
Width across Antitrochanter	90.9-109	101	5.3	22
Maximum Depth	88.7-109.2	99.3	4.2	23
Femur				
Length	175 -218	203	10.1	22
Proximal Width	62.0- 68.0	64.9	2.0	10
Proximal Depth (Trochanter)	55.8- 63.4	59.7	2.5	10
Diameter of Head	23.5- 29.7	26.4	1.5	26
Distal Width	65.4- 79.2	71.7	3.2	26
Depth of External Condyle	64.0- 75.4	69.3	2.9	26
Tibiotarsus				
Length	340 -432	401	21.8	18
Diameter of Shaft, Minimum	19.5- 27.0	23.1	1.8	23
Diameter of Shaft, Maximum	24.6- 34.2	28.1	2.2	23
Proximal Depth	86.2-103	96.2	5.6	9
Proximal Width	47.4- 55.6	52.4	2.8	9
Length of Fibular Crest	74.6-110	90.4	12.1	9
Depth, Internal Condyle	38.7- 47.4	42.7	2.8	9
Depth, External Condyle	36.5- 45.9	41.8	2.1	26
Width, Distal End	38.9- 49.1	45.9	2.2	25
Fibula				
Length	231 -305	272	20.9	12
Proximal Width	13.9- 19.0	17.1	1.5	22
Proximal Depth	35.2- 48.7	38.7	3.0	22
Tarsometatarsus				
Length	332 -422	383	18.0	22
Minimum Diameter of Shaft	11.6- 17.3	14.7	1.5	23
Maximum Diameter of Shaft	16.8- 23.1	19.9	1.5	23
Proximal Width	47.2- 54.0	50.0	2.1	25
Depth of Internal Cotyla	25.4- 27.6	26.6	0.8	9
Depth of External Cotyla	19.9- 23.7	22.0	1.2	9
Depth of Hypotarsus	36.0- 41.3	38.5	1.7	8
Distal Width	47.4- 54.6	51.1	2.0	8
Tarsometatarsus, trochleae				
Width T2	9.0- 11.1	10.0	0.8	9
Width T3	21.9- 28.9	24.9	2.0	24
Width T4	12.2- 14.9	13.6	1.0	9
Depth T2	13.0- 17.6	15.4	1.4	9
Depth T3	19.0- 24.3	22.2	1.8	9
Depth T4	14.3- 17.2	15.6	1.0	9
Pes				
DII P1 Length	40.7- 52.8	47.4	2.8	14
Proximal Depth	16.3- 21.4	18.5	1.7	15
Proximal Width	13.2- 16.4	14.8	0.8	15
DII P2 Length	17.1- 22.4	19.5	2.1	13
Proximal Depth	11.6- 13.3	12.3	0.6	13
Proximal Width	12.4- 15.6	14.0	1.0	13
DII P3 Length	21.4- 28.2	25.9	2.2	9
Proximal Depth	9.4- 12.2	11.0	0.8	10
Proximal Width	10.4- 12.9	11.5	0.9	10
DIII P1 Length	58.1- 65.7	60.5	1.9	14
Proximal Depth	21.3- 27.3	23.6	1.5	15
Proximal Width	25.3- 31.1	27.5	2.0	15
DIII P2 Length	33.4- 42.8	38.8	2.3	13
Proximal Depth	15.0- 18.9	16.9	0.9	15
Proximal Width	20.3- 25.4	22.5	1.6	14

	Range (mm)	$\bar{x}$	s	n
DIII P3 Length	19.5 - 29.3	23.6	2.8	12
Proximal Depth	12.1- 14.1	13.1	0.7	13
Proximal Width	17.2- 20.8	19.0	0.9	13
DIII P4 Length	26.7- 34.4	30.4	2.1	9
Proximal Depth	11.7- 14.9	12.9	1.0	11
Proximal Width	14.8- 17.7	15.6	0.9	11
DIV P1 Length	33.7- 41.2	38.5	2.0	14
Proximal Depth	16.0- 19.8	17.3	0.8	15
Proximal Width	16.0- 19.2	18.0	0.8	15
DIV P2 Length	14.9- 18.2	17.0	1.0	13
Proximal Depth	11.1- 13.2	12.5	0.6	13
Proximal Width	14.2- 16.0	15.1	0.5	13
DIV P3 Length	10.5- 14.4	12.0	1.1	11
Proximal Depth	9.9- 12.1	11.0	0.6	12
Proximal Width	12.5- 14.9	13.2	0.6	12
DIV P4 Length	6.4- 12.3	9.7	1.6	11
Proximal Depth	8.7- 10.7	10.1	0.6	11
Proximal Width	10.4- 13.4	12.0	0.8	11
DIV P5 Length	19.2- 24.3	22.2	1.6	8
Proximal Depth	9.3- 11.8	10.5	0.7	10
Proximal Width	10.1- 11.5	10.9	0.5	10
Vertebrae				
C1 Length, Ventral	5.0- 7.9	6.1	0.8	12
Depth of Hypopophysis	5.3- 6.1	5.8	0.3	11
Maximum Width across Arch	12.8- 16.5	14.5	1.4	9
Depth	14.9- 17.7	16.1	0.8	12
Prearticular Surface	6.2- 8.5	7.1	0.7	12
Postarticular Surface	9.0- 11.3	10.4	0.8	10
Dorsal Length	5.8- 7.3	6.4	0.5	10
C2 Depth	25.7- 30.9	28.1	1.4	16
Width across Postzygapophyses	20.4- 24.9	22.3	1.3	16
Width across Diapophyses	12.2- 15.5	13.8	1.0	16
Width across Postarticular surface	6.3- 8.7	7.3	0.7	16
Width across Prearticular surface	9.7- 11.4	10.5	0.5	14
Centrum Length	15.9- 20.5	18.3	1.5	15
Length from Pre- to Post Zygapophyses	14.1- 17.9	16.6	1.1	12
C3 Depth	21.0- 26.1	23.7	1.3	15
Postzygapophyses	22.7- 28.2	25.4	1.4	16
Diapophyses	17.7- 23.5	21.0	1.4	15
Postarticular Surface	6.9- 9.6	8.4	0.7	16
Prearticular Surface	8.1- 10.9	9.1	0.8	16
Centrum length	16.5- 21.2	18.9	1.4	16
Pre-postzygapophyses	22.3- 27.8	29.8	1.7	16
C4 Depth	18.1- 22.6	20.2	1.3	16
Postzygapophyses	22.1- 26.4	24.5	1.3	16
Diapophyses	21.6- 26.8	23.6	1.3	16
Postarticular Surface	9.5- 13.0	11.3	1.2	16
Prearticular Surface	7.9- 12.0	10.3	0.9	16
Centrum Length	20.5- 25.3	22.7	1.6	16
Pre-postzygapophyses	26.4- 32.3	29.4	1.9	16
C5 Depth	14.9- 19.3	17.1	1.2	17
Postzygapophyses	12.8- 19.5	17.0	1.6	17
Diapophyses	25.0- 28.6	26.2	1.1	17
Postarticular Surface	13.6- 19.7	16.0	1.6	17
Prearticular Surface	10.5- 15.7	13.3	1.6	17
Centrum Length	22.4- 26.7	25.2	1.3	17
Pre-postzygapophyses	30.8- 40.6	36.0	2.5	17
C6 Depth	13.9- 19.7	16.5	1.3	17
Postzygapophyses	11.6- 16.4	13.6	1.2	17

	Range (mm)	$\bar{x}$	s	n
Diapophyses	17.4– 31.1	27.8	3.1	17
Postarticular Surface	16.8– 20.6	18.7	1.3	17
Prearticular Surface	14.5– 19.9	17.4	1.7	17
Centrum Length	25.3– 29.4	27.8	1.3	17
Pre-postzygapophyses	35.7– 42.2	38.8	1.8	17
C7 Depth	15.0– 19.0	16.9	1.2	17
Postzygapophyses	11.5– 17.9	14.0	1.8	17
Diapophyses	27.8– 32.9	30.4	1.7	17
Postarticular Surface	15.2– 20.1	18.0	1.6	17
Prearticular Surface	18.9– 24.1	21.0	1.4	17
Centrum Length	28.5– 32.3	30.7	1.3	17
Pre-postzygapophyses	35.7– 41.4	38.4	1.5	17
C8 Depth	16.2– 19.9	18.0	1.1	17
Postzygapophyses	12.1– 19.7	16.8	2.2	17
Diapophyses	18.4– 34.2	30.4	3.6	17
Postarticular Surface	14.4– 19.1	16.9	1.4	17
Prearticular Surface	16.8– 32.2	20.8	3.5	17
Centrum Length	23.6– 35.6	32.9	2.8	17
Pre-postzygapophyses	36.5– 40.5	38.6	1.3	17
C9 Depth	18.2– 22.7	20.2	1.2	17
Postzygapophyses	16.3– 25.0	20.8	2.0	17
Diapophyses	28.4– 34.5	31.2	1.8	17
Postarticular Surface	13.4– 17.9	15.4	1.3	17
Prearticular Surface	16.1– 21.7	19.0	1.4	17
Centrum Length	34.2– 38.7	36.2	1.4	17
Pre-postzygapophyses	38.2– 45.3	40.4	1.9	17
C10 Depth	19.7– 23.6	21.7	1.2	17
Postzygapophyses	19.8– 27.2	22.9	1.6	17
Diapophyses	28.8– 34.7	31.0	1.8	17
Postarticular Surface	12.6– 16.7	14.8	1.2	17
Prearticular Surface	15.2– 21.1	17.5	1.7	17
Centrum Length	36.0– 40.8	38.4	1.6	17
Pre-postzygapophyses	40.5– 50.6	44.2	2.3	17
C11 Depth	21.0– 24.9	23.2	1.2	17
Postzygapophyses	21.2– 27.5	23.4	1.5	17
Diapophyses	29.4– 34.7	31.5	1.6	17
Postarticular Surface	13.8– 18.4	15.4	1.4	17
Centrum Length	37.7– 43.2	40.7	1.7	17
Pre-postzygapophyses	43.6– 53.2	47.3	2.2	17
Prearticular Surface	15.1– 19.9	16.9	1.6	17
C12 Depth	23.0– 27.1	24.6	1.3	17
Postzygapophyses	20.2– 27.5	23.8	1.7	17
Diapophyses	30.1– 35.0	25.0	1.5	17
Postarticular Surface	14.6– 19.4	16.5	1.5	17
Prearticular Surface	15.4– 23.1	17.9	2.3	17
Centrum Length	39.5– 44.4	42.4	1.5	17
Pre-postzygapophyses	44.9– 53.7	49.7	2.3	17
C13 Depth	23.3– 28.2	25.7	1.5	17
Postzygapophyses	20.3– 27.0	23.8	1.9	17
Diapophyses	30.7– 37.3	33.7	1.7	17
Postarticular Surface	16.2– 20.6	17.8	1.4	17
Prearticular Surface	15.5– 22.6	18.9	1.9	17
Centrum Length	40.4– 45.9	43.6	1.6	17
Pre-postzygapophyses	47.7– 54.4	51.9	1.9	17
C14 Depth	24.3– 29.7	26.9	1.5	17
Postzygapophyses	20.7– 26.4	23.9	1.7	17
Diapophyses	32.0– 38.5	35.2	1.6	17
Postarticular Surface	17.3– 22.2	19.2	1.4	17
Prearticular Surface	17.1– 23.4	20.4	1.9	17

	Range (mm)	x̄	s	n
Centrum length	41.0– 46.5	44.3	1.7	17
Pre-postzygapophyses	48.6– 56.6	52.8	2.3	17
C15 Depth	25.6– 32.2	28.6	2.0	17
Postzygapophyses	21.4– 27.4	24.1	1.6	17
Diapophyses	34.5– 40.9	37.1	2.0	17
Postarticular Surface	19.0– 23.5	21.2	1.4	17
Prearticular Surface	17.6– 25.9	22.0	2.1	17
Centrum Length	41.2– 47.4	44.9	1.8	17
Pre-postzygapophyses	49.8– 58.4	53.6	2.5	17
C16 Depth	27.5– 33.5	30.5	2.1	16
Postzygapophyses	22.4– 28.1	25.4	1.7	16
Diapophyses	36.9– 45.7	40.7	2.6	16
Postarticular Surface	20.5– 25.7	23.3	1.6	16
Prearticular Surface	20.4– 29.2	24.1	2.2	16
Centrum Length	41.9– 48.5	45.3	1.9	16
Pre-postzygapophyses	51.1– 60.8	55.0	2.8	16
C17 Depth	29.3– 41.1	33.8	3.2	17
Postzygapophyses	25.1– 30.4	27.2	1.9	17
Diapophyses	41.8– 51.4	45.7	3.2	17
Postarticular Surface	20.9– 27.6	24.5	1.9	17
Prearticular Surface	23.5– 32.4	26.5	2.2	17
Centrum Length	42.5– 48.7	45.5	2.0	17
Pre-postzygapophyses	50.0– 61.2	55.6	2.8	17
C or V18 Depth	34.0– 56.3	41.2	5.5	16
Postzygapophyses	25.3– 32.7	28.4	2.0	16
Diapophyses	46.5– 68.4	53.6	5.7	16
Postarticular Surface	21.9– 29.0	25.3	1.8	16
Prearticular Surface	22.4– 31.1	27.6	2.6	16
Centrum Length	42.3– 48.2	45.1	1.8	16
Pre-postzygapophyses	48.4– 60.6	55.4	3.0	16
V19 Depth	43.0– 66.4	50.7	6.3	17
Postzygapophyses	25.2– 31.3	28.3	1.7	17
Diapophyses	56.5– 70.6	61.7	4.0	17
Postarticular Surface	21.6– 27.8	24.9	1.8	17
Prearticular Surface	23.4– 33.1	27.4	2.5	17
Centrum Length	40.9– 47.5	44.4	1.9	17
Pre-postzygapophyses	51.4– 58.4	54.2	3.1	17
V20 Depth	50.7– 77.1	62.6	5.7	17
Postzygapophyses	23.7– 30.2	26.5	1.9	17
Diapophyses	62.1– 81.8	67.5	4.6	17
Postarticular Surface	20.5– 25.6	23.3	1.5	17
Prearticular Surface	23.7– 34.0	27.6	2.7	17
Centrum Length	40.4– 47.6	42.8	1.8	17
Pre-postzygapophyses	49.7– 58.3	54.2	2.4	17
V21 Depth	56.6– 78.1	68.0	5.5	17
Postzygapophyses	23.4– 29.1	26.2	1.6	17
Diapophyses	61.3– 82.0	68.2	4.8	17
Postarticular Surface	19.6– 26.5	22.7	1.5	17
Prearticular Surface	21.4– 29.4	25.3	2.0	17
Centrum Length	37.2– 46.3	42.1	2.4	17
Pre-postzygapophyses	47.9– 57.0	51.9	2.7	17
V22 Depth	57.1– 74.9	64.7	6.1	17
Postzygapophyses	22.4– 30.5	26.7	2.0	17
Diapophyses	61.0– 76.8	67.0	3.7	17
Postarticular Surface	19.8– 29.1	23.3	2.3	17
Prearticular Surface	21.9– 29.1	24.5	1.9	17
Centrum Length	38.3– 45.5	41.5	2.2	17
Pre-postzygapophyses	47.2– 57.8	50.7	2.9	17

	Range (mm)	$\bar{x}$	s	n
V23 Depth	55.7– 72.9	63.4	3.3	17
Postzygapophyses	25.8– 33.1	28.2	2.1	17
Diapophyses	60.9– 74.4	67.2	3.9	17
Postarticular Surface	21.0– 26.7	23.7	1.4	17
Prearticular Surface	20.3– 29.0	24.4	2.2	17
Centrum Length	37.8– 43.7	40.4	1.7	17
Pre-postzygapophyses	43.8– 51.6	47.1	2.1	17
V24 Depth	60.2– 79.9	68.7	4.6	17
Postzygapophyses	26.1– 33.8	30.4	2.2	17
Diapophyses	62.1– 75.5	68.7	4.1	17
Postarticular Surface	19.8– 28.4	24.3	2.3	16
Prearticular Surface	21.3– 28.8	24.7	2.3	17
Centrum Length	37.5– 46.1	41.3	2.0	17
Pre-postzygapoplyses	43.2– 52.1	46.9	2.1	17
V25 Depth	63.7– 85.9	74.1	5.2	17
Postzygapophyses	27.9– 40.2	33.8	2.8	17
Diapophyses	43.4– 76.2	68.7	7.7	17
Postarticular Surface	20.3– 27.3	23.8	1.9	17
Prearticular Surface	20.4– 30.3	25.2	2.5	16
Centrum Length	36.8– 44.4	41.2	2.0	17
Pre-postzygapophyses	42.3– 52.9	46.3	2.2	17
V26 Depth	68.5– 87.8	79.4	5.2	15
Postzygapophyses	26.2– 40.9	33.7	3.9	16
Diapophyses	59.7– 75.6	69.2	4.6	15
Postarticular Surface	23.0– 30.4	25.0	1.9	15
Prearticular Surface	23.1– 38.7	25.8	3.8	15
Centrum Length	33.3– 49.4	40.6	3.6	16
Pre-postzygapophyses	41.2– 50.7	45.3	2.9	15

TABLE 3. Measurements (in mm) of skull material of fossil emus (Dromaiinae) from Australia.

SPECIMEN	Width	Depth	Diameter, Foramen Magnum	Lower Jaw, Symphysial Length
NMV P157345	75.0 (est.)	47.4	10.8	—
NMV P157350	—	—	—	21.5
NMV P157353	>65.2	48.5	10.7	—
SAM P17834	—	—	—	24.5

TABLE 4. Measurements (in mm) of vertebrae of fossil emus (Dromaiinae) from Australia.

	Measurements							
	Width							
SPECIMEN	Depth	Postzyg.	Diapop.	Posterior Articulation	Anterior Articulation	Length of Centrum	Length across Zygopop.	Vertebral Number
MM F16786	—	42.2 (est.)	—	25.5+	30.0 (est.)	37.7	46.3	V24?
MM F16797	—	31.8	—	27.0	27.2	38.8	42.1	V26 or 25?
NMV P157346	—	23.6	—	20.2	23.2	39.3	46.3	V21 or 22
NMV P157349	—	—	62.8 (est.)	21.4	22.2 (est.)	36.0	—	V23 or 24
NMV P157351	14.3	9.7	24.6	16.9	12.8	24.5	30.2	C7? (juv)
NMV P157352	18.2	17.7	—	11.9	12.4 (est.)	31.2	37.8	C11-13? (juv)
NMV P157359	22.5	26.1	21.7	8.7	9.2	17.5	24.2	C3
NMV P157364	—	—	68.0 (est.)	—	—	—	—	V25 or 26
NMV P157367	—	19.8	46.8 (est.)	—	—	—	>36.3	V20-21 (juv)
NMV P157368	16.6+	16.6+	—	11.0	16.2 (est.)	29.2	32.4	?C11 (juv)
NMV P157369	—	—	—	21.4 (est.)	26.0 (est.)	27.0	—	V22-26 (juv)
SAM P17589	29.7	23.1	39.7	21.8	23.1	47.4	54.0	C16 (15-17?)
SAM P18246	19.9	23.9	22.5	10.7	9.8	23.2	29.5	C4
SAM P18673	30.5	27.5	37.9+	20.6	18.8+	48.1	—	C15-C17
SAM P18830	—	33.4	—	27.4	>25.6	39.7	44.0	V26?
SAM P18247	—	—	68.0 (est.)	24.8		41.9	—	V22 or 23
AMNH 9678	—	26.0 (est.)	—	—	—	—	—	C2
AMNH 9678	24.2+	30.0 (est.)	22.0 (est.)	—	11.2 (est.)	22.5+	26.7	C3
AMNH 9678	>20.2	29.1	25.9	12.6	11.7	25.6	33.1	C4
AMNH 9678	18.0	16.8	32.9	22.8	19.5	32.4	46.6	C6?
AMNH 9678	19.1	16.3	34.9	23.1	23.3	35.5	45.5	C7?
AMNH 9678	21.7	—	36.4	—	22.5	>37.8	48.0	C9?
UCMP 56642	—	—	—	—	—	41.7	48.5	V21 or 22
UCMP 56855	—	—	—	23.3	25.7	46.6	—	V22 or 23

TABLE 5. Measurements (in mm) of vertebral ribs of fossil emus (Dromaiinae) from Australia.

SPECIMEN	Width of Facets
NMV P157354	>36.8
NMV P157358	~34.3
NMV P157362	>28.0
SAM P18107	29.3
SAM P18784	34.1
SAM P22812 (in part)	38.6
UCMP 60560	34.8

TABLE 6. Measurements (in mm) of sterna of fossil emus (Dromaiinae) from Australia.

SPECIMEN	Maximum Length	Maximum Width	Number of Costal Processes	Width of first Costal Process	Width of last Costal Process	Length of Costal Margin	Length of Sterno-coracoidal Process	Width of Cora-coidal Sulci	Anterior Depth
D. novaehollandiae									
NMV P157347	—	124	3	~118	—	—	—	~52.6	14.6
NMV P157355	—	112	4	109	90.9	49.7	16.4	—	—
D. sp.									
AMP 25218	147	118	4	~127	109	64.2	—	70.5	17.9

TABLE 7. Measurements (in mm) of synsacra of fossil emus (Dromaiinae) from Australia.

SPECIMEN	Diameter of Acetabular Foramen	Width across Antitrochanter	Length of Acetabular Complex	Depth of Acetabular Complex
D. novaehollandiae				
NMV P157361	—	>83.6	56.3	—
SAM Unreg.	15.5	—	—	—
SAM P16501	18.0	108	—	—
SAM P17767	12.2	104	60.7	33.8
UCMP 56333	17.4	—	62.3	36.8

TABLE 8. Measurements (in mm) of femora of fossil emus (Dromaiinae) from Australia.

SPECIMEN	Length	Proximal Width	Proximal Depth (Trochanter)	Diameter of Head	Distal Width	Depth of External Condyle	
D. novaehollandiae							
HM B775/869	190	—	—	—	59.6	61.2	R
HM B801/934	—	—	—	—	—	76.2	d,R
RHT 1064	190	65.1	—	27.6	—	—	R
SAM Unreg.	—	—	—	27.4	>76.3	76.7	
SAM P17104	—	~67.2	~61.2	~28.0	—	—	p,L
SAM P22812	204	67.4	61.4	25.5	68.8	—	L
AMNH 9677	—	—	—	—	83.3	70.7	d,R
D. cf. ocypus							
UCMP RAS5176	190	59.5	—	—	—	—	p,L

TABLE 9. Measurements (in mm) of tibiotarsi of fossil emus (Dromaiinae) from Australia.

SPECIMEN	Length	Diameter of Shaft Minimum	Diameter of Shaft Maximum	Proximal Depth	Proximal Width	Length, Fibular Crest	Depth, Internal Condyle	Depth, External Condyle	Width, Distal End	
D. novaehollandiae										
AM 49713	—	—	—	113	57.8	—	—	—	—	p,R
AM 'B'	—	—	—	—	—	—	45.1	—	46.6	d,L
AM F10949	—	—	—	—	—	—	>35.0	31.2	38.1	d,L
AM P5802	—	—	—	—	—	—	41.0	42.1	47.3	d,R
MM F16775	—	—	—	—	—	—	44.9	44.3	49.5	d,R
NMV P44011	—	22.1	26.6	>76.0	>44.1	93.1	—	—	—	R
NMV P150013	—	24.9	32.7	—	—	95.1	44.7	40.2	50.4	d,L
NMV P157356	—	—	—	>92.2	47.4	—	—	—	—	p,R
NMV P157357	—	—	—	—	—	—	39.1+	39.1	43.3	d,L
NMV P157360	—	—	—	—	—	—	>39.3	39.3	41.8	d,L
NMV P157365	—	21.1	29.2	>91.5	49.2	96.4	—	—	—	p,R
QM F1652	—	—	—	—	56.1	>80.5	—	—	—	p,L
SAM P17149	—	—	—	—	—	—	42.7	—	43.6	d,R
SAM P18829	—	—	—	—	—	—	>38.8	41.3+	>37.5	d,R
SIAM 61	384	23.3	32.3	102	56.9	88.6	45.8	43.9	51.8	L
UCMP 53825 (RHT6)	—	—	—	—	—	—	37.0	35.1	37.4	d,L
UCMP 53825 (RHT25)	—	—	—	—	—	—	37.0	34.9	35.6	d,L
UCMP 56845	—	—	—	—	—	—	—	38.8	40.6+	d,L
WAM 68.5.34	—	21.6	26.3	—	—	107	—	—	—	L
D. 'patricus'										
MM F12074	—	—	—	—	—	—	35.5	34.3+	41.3	d,R
QM F5547	—	—	—	—	57.6	>90.2	—	—	—	p,R
QM F5548	—	—	—	—	—	—	46.2	45.7	48.6	d,L
D. cf. *ocypus*										
UCMP RAS5182	—	—	—	—	—	—	43.0	40.8	46.0	d,R
D. gidju										
SAM P26779	—	—	—	—	—	—	31.8	31.3	32.0	d,L

TABLE 10. Measurements (in mm) of tarsometatarsi of fossil emus (Dromaiinae) from Australia.

SPECIMEN	Length	Diameter of Shaft		Proximal Width	Depth, Internal Cotyla	Depth, External Cotyla	Depth, Hypotarsus	Distal Width	
		Minimum	Maximum						
D. novaehollandiae									
AM Unreg.	—	—	—	56.7	25.9	24.5	42.5+	—	p,R
AM 'C'	—	—	—	53.9	25.2	21.3	40.5+	—	p,L
AM F771	—	11.8+	20.5	—	—	—	—	47.5	d,R
AM F18935	—	14.0	19.4	—	—	—	—	>46.2	d,L (juv)
AM P58026	—	—	—	53.0	23.2+	19.1+	39.5+	—	p,R
NMV L5	—	—	—	—	—	—	—	54.1+	d,L
NMV P44012	—	14.1	21.9	>42.3	—	—	>34.0	52.4	R
NMV P44013	—	16.1	22.2	48.3	26.3	22.5+	>35.1	55.9	R
NMV P44014	—	14.9	19.8	49.8	24.2	21.4	37.5+	52.2	R
NMV P44015	—	14.0	19.5	46.5	24.0+	19.8	>37.0	—	R
NMV P44016	—	15.5	20.4	—	23.0	>21.8	>38.2	51.2	L
NMV P44017	—	13.3	21.7	—	—	—	—	>50.5	d,L
NMV P44018	—	13.8	23.1	—	—	—	—	54.0+	d,L
NMV P48392	—	12.2	21.0	—	—	—	—	—	d,R
NMV P150015	—	16.7	23.6	—	—	—	—	—	d,R
NMV P157343	—	13.0	19.3	>39.0	—	—	>32.4	—	L
NMV P157344	—	14.2	19.6	—	—	—	—	—	d
QM F1143 (in part)	—	15.4	25.7	—	—	—	—	56.1	L
SAM P13118	—	12.6	—	—	—	—	—	—	d,R
SAM P17816	—	16.0	23.4	—	—	—	—	53.5	d,L
SAM P18693	—	16.7	23.9	49.0 (est.)	—	—	—	56.3	L
UCMP 53835	—	13.9	18.7+	—	—	—	—	39.0	d,R
UCMP 56313	—	13.5+	—	—	—	—	—	—	d,R
WAM Unreg. 190	—	—	—	33.8	—	—	—	—	(juv)
WAM 68.5.34	>330	16.6	18.2	—	—	—	—	—	L
D. 'gracilipes'									
QM F1142	—	10.9	21.5	—	—	—	—	—	d,L (juv)
'Metapteryx bifrons'									
QM F1135	—	—	—	—	—	—	—	34.1	d,L (juv)
D. ocypus									
SAM P13444	330	—	—	47.1	21.2	20.9	35.5+	53.0	R
D. gidju									
SAM P26779	—	—	—	35.0	18.9	14.8+	26.9+	—	p,L
D. sp.									
AM 'A'	—	10.3	17.1	—	—	—	—	—	d (juv)
AM F10850	—	—	—	46.4	—	—	—	—	p,L
NMV P35578	—	16.2	28.0	—	—	—	—	—	d,R
Aves, indet.									
SAM P11552	—	21.2	28.0	—	—	—	—	63.7	d,L

TABLE 11. Measurements (in mm) of the distal ends of tarsometatarsi of fossil emus (Dromaiinae) from Australia.

	Width, T2	Width, T3	Width, T4	Depth, T2	Depth, T3	Depth, T4
D. novaehollandiae						
AM F771	9.1	23.8	12.2	12.1	20.3	13.9
AM F18935	—	24.1	12.3	—	24.1	14.2
QM F1135	5.9	15.7	7.5	8.8	13.8	9.4
QM F1143 (in part)	10.9	27.2	14.3	15.3	25.0	15.8
QM F1143 (in part)	—	23.0	—	—	22.6	—
NMV L5	>10.5	24.8+	13.2+	>14.0	25.2+	15.9
NMV P44012	> 9.2	24.3	12.8+	13.1+	22.3+	16.0
NMV P44013	9.8+	24.3	14.5+	15.1	23.8	16.8
NMV P44014	10.9	26.4	13.2	14.8	22.5	15.7
NMV P44015	—	—	—	—	21.4+	—
NMV P44016	10.3	25.9	13.3	13.8	21.4	14.7
NMV P44017	> 8.8	>23.3	>13.1	14.8	23.3	15.4
NMV P44018	> 9.0	25.0+	14.8	13.4+	20.4+	14.7+
NMV P48392	—	—	>10.5	—	>21.5	12.4+
NMV P150014	11.3	28.3	—	15.0+	24.0	—
NMV P150015	14.9+	25.1	—	11.6	29.8	—
SAM P13118	—	—	11.9	—	20.2+	12.7
SAM P17816	10.0	27.8	>13.3	15.0	23.1	15.6
SAM P18693	12.6	29.8	15.6	>15.3	25.6	>18.0
UCMP 53835	—	>18.4	—	—	—	—
UCMP 56313	10.7	27.9	—	15.3	23.1	—
D. 'gracilipes'						
QM F1142	—	16.6	—	—	16.5	—
D. ocypus						
SAM P13444	10.6	27.8	13.5	14.7	21.9	15.7
D. sp.						
AM 'A'	—	16.5	—	—	~14.7	—
QM QA205	—	~16.1	—	—	>14.4	—
QM QA416	13.3*	—	—	23.9*	—	—
QM QA505	8.5	17.5	—	11.9	16.8	—
UCMP RAS5397 (in part)	—	15.7+	—	—	14.0+	—
Aves indet.						
SAM P11552	—	>26.3	>14.5	—	>27.5	—

* perhaps T4

TABLE 12. Measurements (in mm) of phalanges of fossil emus (Dromiinae) from Australia.

SPECIMEN	Phalanx	Length	Proximal Depth	Proximal Width	Element
D. novaehollandiae					
SAM P18059	P1,DII	45.0	20.0	14.8	L
SAM P18248	P2,DII	37.6	17.8	23.8	R
SAM P18249	P1,DIV	38.2	17.6	18.8	R
UCMP 53832	P4,DII or DIV	20.6	10.6	10.5	
UCMP 53832	P1,DII	—	16.7	13.4	p
UCMP 53832	P2,DIV	16.3	12.3	14.1	L
UCMP 53833	P1,DIV	34.2	16.1	17.8	L
UCMP 53833	P5,DIV?	20.0+	9.6	8.6+	
UCMP 55983	P1,DIII	53.2	20.8	25.7	L
UCMP 55983	P2,DIII	36.2	13.9	21.3	L
UCMP 56849	P1,DII	43.0	18.9	17.0	L
UCMP 94679	P1,DIII	48.4	18.9	24.0	
UCMP 94680	P2,DIII	37.0	18.8	21.4	L
D. gidju					
SAM P26779	P1,DII	33.1	14.2	12.9	L
SAM P26779	P2,DII	23.5	11.8	11.6	L
SAM P26779	P3,DII	19.3	10.1	8.9	L
SAM P26779	P1,DIII	45.1	16.7	19.5	L
SAM P26779	P2,DIII	31.7	12.9	15.2	L
SAM P26779	P3,DIII	22.5	10.5	13.0	L
SAM P26779	P4,DIII	18.4	9.8	10.5	L
SAM P26779	P1,DIV	29.2	13.0	14.0	L
SAM P26779	P2,DIV	16.1	10.6	10.8	L
SAM P26779	P3,DIV	10.8	9.2	9.4	L
SAM P26779	P4,DIV	8.8	7.9	8.2	L
SAM P26779	P5,DIV	15.6	8.8	7.7	L
D. sp.					
QM QA504	P1,DIII	41.5	15.3	16.8	R
UCMP RAS 5397	P2,DII	19.8	11.9	10.9	L

TABLE 13. Measurements (in mm) of the fibula of fossil emus (Dromaiinae) from Australia.

SPECIMEN	Proximal Width	Proximal Depth	Element
NMV P157363	17.0	36.4	p,L

FIGURE 1. *Dromaius gidju*, n. sp. Type from the Wipajiri Fm. Leaf Locality, Lake Ngapakaldi, Kutjamarpu fauna, Miocene. A,B, stereo pair of pes, dorsal view. C,D,E,F, tarsometatarsi in posterior (C), anterior (D) and proximal (E,F, stereo pair) views. G,H,I,J,K, distal left tibiotarsus in anterior (G), posterior (H), distal (I), internal (J), and external (K) views. Scale indicates 1 cm.

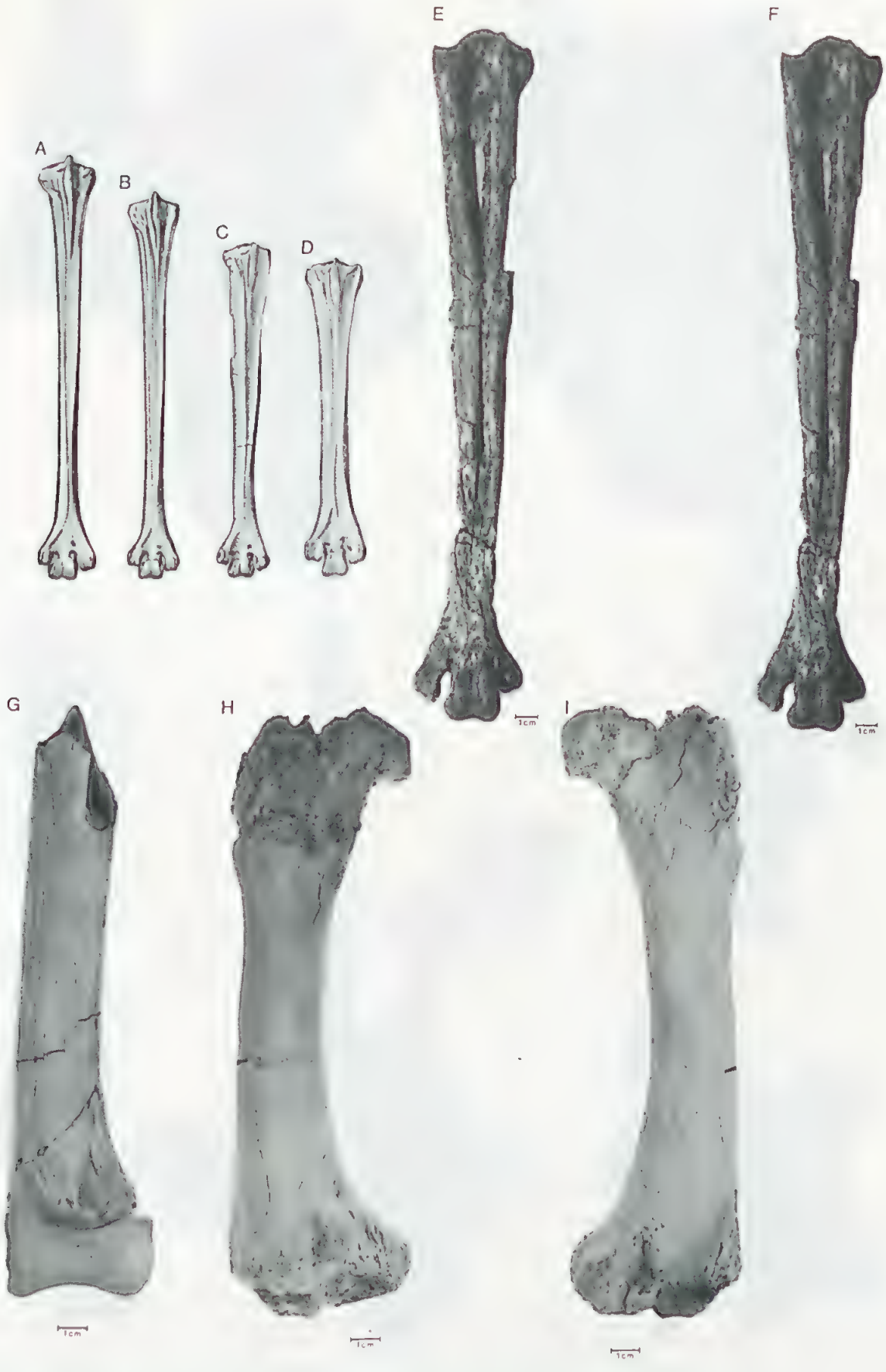

FIGURE 2. Mid-Cainozoic emu fossils from northern South Australia and living casuariids. A–D, posterior views of tarsometatarsi of (A,B) the extant *Dromaius novaehollandiae*, (C) *D. ocypus* (SAM P13444), and (D) the extant *Casuarius unappendiculatus* (from Miller, 1963). E,F, stereo pair in anterior view, tarsometatarsus, the type specimen of *Dromaius ocypus*, SAM P13444, Pliocene, Lawson-Daily Quarry, Mampuwordu Sands, Lake Palankarinna, Palankarinna fauna. G, distal tibiotarsus in anterior view of *D.* cf. *ocypus*, RAS 5182, Pliocene. H,I, femur of *D.* cf. *ocypus*, in posterior (H) and anterior (I) views, RAS 5176, Pliocene.

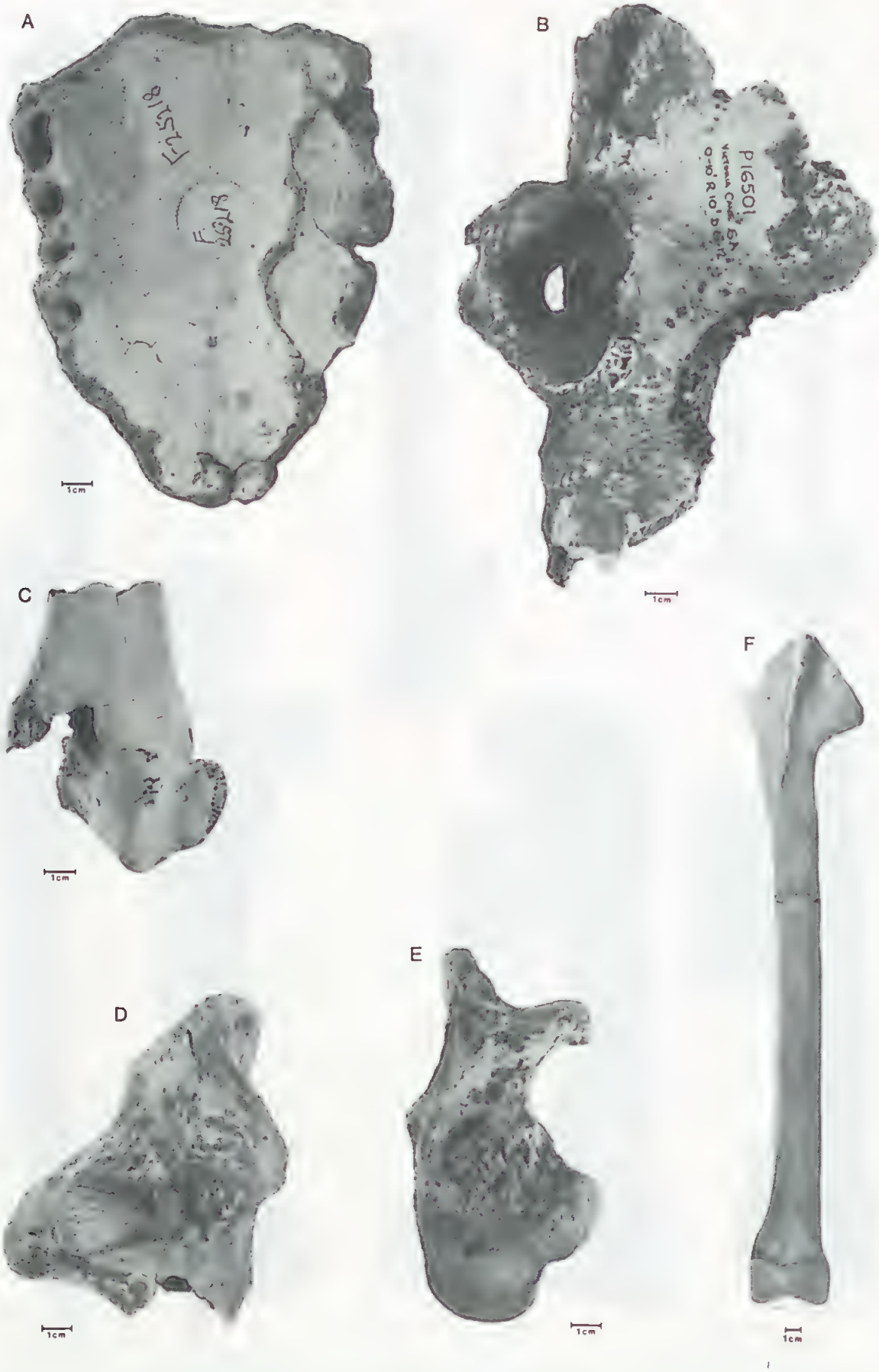

FIGURE 3. A variety of late Cainozoic emu fossils. A, sternum of *Dromaius* sp. in dorsal view, AM F25218. B, pelvic fragment of *D. novaehollandiae* in lateral view, SAM P16501. C, distal left femur in posterior view of *D. novaehollandiae*, HM B801/B934. D,E, proximal right tibiotarsus in lateral (D) and proximal (E) views. F, left tibiotarsus in anterior view, SIAM 61.

FIGURE 4. A variety of late Cainozoic emu fossils. A, distal right tibiotarsus in anterior view, one of the original type specimens of *Dromaius 'patricus'* De Vis, QM F5548. B, QM F1120 considered by C.W. De Vis to be a coracoid of *D. patricus*, but non-avian. C, distal left tarsometatarsus of *'Metapteryx bifrons'* De Vis in anterior view, QM F1135, originally designated a kiwi but actually a juvenile *D. novaehollandiae*. D, distal tarsometatarsus of *D. 'gracilipes'* De Vis in anterior view, QM F1142, a juvenile *D. novaehollandiae*. E, distal left tarsometatarsus of Aves indet. *cf.* dromornithid in anterior view, SAM P11552, assigned previously as emu. F,H, tarsometatarsus fragment of a small *D. novaehollandiae* in anterior (F) and posterior (H) views, AM 'A', no locality or age data available. G,I,J, second and third trochleae of a small *Dromaius* in posterior (G), distal (I), and posterior (J) views, QW QA505. K–N, phalanges of *D. novaehollandiae* in dorsal views. (K) phalanx 1 digit III, UCMP 94679; (L) phalanx 2, digit III, UCMP 94680; (M) phalanx 1, digit II, UCMP 56849; and (N) ungual phalanx 4, digit III, UCMP 60563.

ECHIURANS FROM AUSTRALIA (ECHIURA)

S. J. EDMONDS

EDMONDS, S. J. 1987. Echiurans from Australia (Echiura). *Rec. S. Aust. Mus.* 32(2) 119–138.

Seventeen species of euchiurans are recorded from Australia of which nine are redescribed, and none are new. One, *Anelassorhynchus porcellus adelaidensis*, is given new status. *Listriolobus bulbocaudatus* Edmonds, 1963 is now considered a junior synonym of *L. brevirostris* Chen & Chen Chang, 1958, *Ochetostoma myersae* Edmonds, 1963 a junior synonym of *O. baroni* Greeff, 1879 and *Austrobonellia mjoebergi* (Fischer, 1921) a junior synonym of *Pseudobonellia biuterina* Johnston & Tiegs, 1919. A key to the Australian species is given.

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Echiurans are soft-bodied, protostomous, coelomate, worm- to sausage-shaped, marine invertebrates that resemble annelids and sipunculans. Because they are largely subtidal and occur in burrows and protected places echiurans are not always easy to find. They have, however, been collected in tropical, temperate and polar seas and are known from the littoral to the ultra-abyssal regions of the oceans. More than 150 species have been described.

Records of Australian echiurans are few and scattered (Haswell 1885, Whitelegge 1899, Augener 1903, Hedley 1906, Dakin 1916 and 1952, Fischer 1919 and 1921, Johnston & Tiegs 1919 and 1920, Monro 1931, Edmonds 1960, 1963, 1966 and 1982, Nielsen 1963, Dartnall 1970 and 1976) and only 16 species have so far been reported, of which three are well known. In Australia echiurans have been found in burrows in mud and sand, in limestone rocks and in coral, in tangled roots of sea-grasses, under stones and in cracks and fissures in rocks. Some have been dredged. The best known Australian echiurans (and ones that can be readily collected) are *Metabonellia haswelli, Anelassorhynchus porcellus adelaidensis* and *Ochetostoma australiense*. Scuba divers report the presence of large numbers of the first in shallow water at Encounter Bay, S.A., between Wright I. and the Bluff and from the islands comprising the Banks Group in Spencer Gulf, S.A. and of the second species from Coobowie and Edithburg in St Vincent Gulf, S.A. Large numbers of *O. australiense* occur at Caloundra and Dunwich, Qu., the species feeding from the surface of intertidal mud flats at low water. In other parts of the world they have also been found in the empty shells of molluscs and in sand dollars. Most of the specimens examined in the present study were found intertidally by collectors or subtidally by divers and are now in the collections of State Museums.

The classification used in this paper is that outlined by Stephen & Edmonds (1972), which in turn is based on that of Fisher (1946).

List of Australian Echiurans

The species marked '*' have not been examined by the author. Records of species marked '?' are considered doubtful.

Family Bonelliidae

Metabonellia haswelli (Johnston & Tiegs)
Pseudobonellia biuterina Johnston & Tiegs
?* *Archibonellia michaelseni* Fischer
* *Zenkevitchiola brevirostris* Murina
* *Sluiterina alba* Murina
* *Vitjazema ultraabyssalis* Murina
* *Protobonellia papillosa* Murina

Family Echiuridae

Anelassorhynchus porcellus porcellus Fisher
Anelassorhynchus porcellus adelaidensis Edmonds *n. status.*
?* *Anelassorhynchus vegrandis* (Lampert)
Arhynchite hiscocki Edmonds
Listriolobus brevirostris Chen & Yeh Chen-Chang
?* *Listriolobus sorbillans* (Lampert)
Ochetostoma baroni (Greeff)
Ochetostoma australiense Edmonds
Thalassema sydniense Edmonds

Family Ikedaidae

Ikeda sp.

The following abbreviations are used in this paper: AMS (Australian Museum, Sydney), MV (Museum of Victoria, Melbourne), SAM (South Australian Museum, Adelaide), WAM (Western Australian Museum, Perth), TMH (Tasmanian Museum, Hobart), N.S.W. (New South Wales), Qu. (Queensland), S.A. (South Australia), Tas. (Tasmania), Vic. (Victoria), W.A. (Western Australia.). The anatomy of a 'generalised' echiuran is shown in Fig. 1.

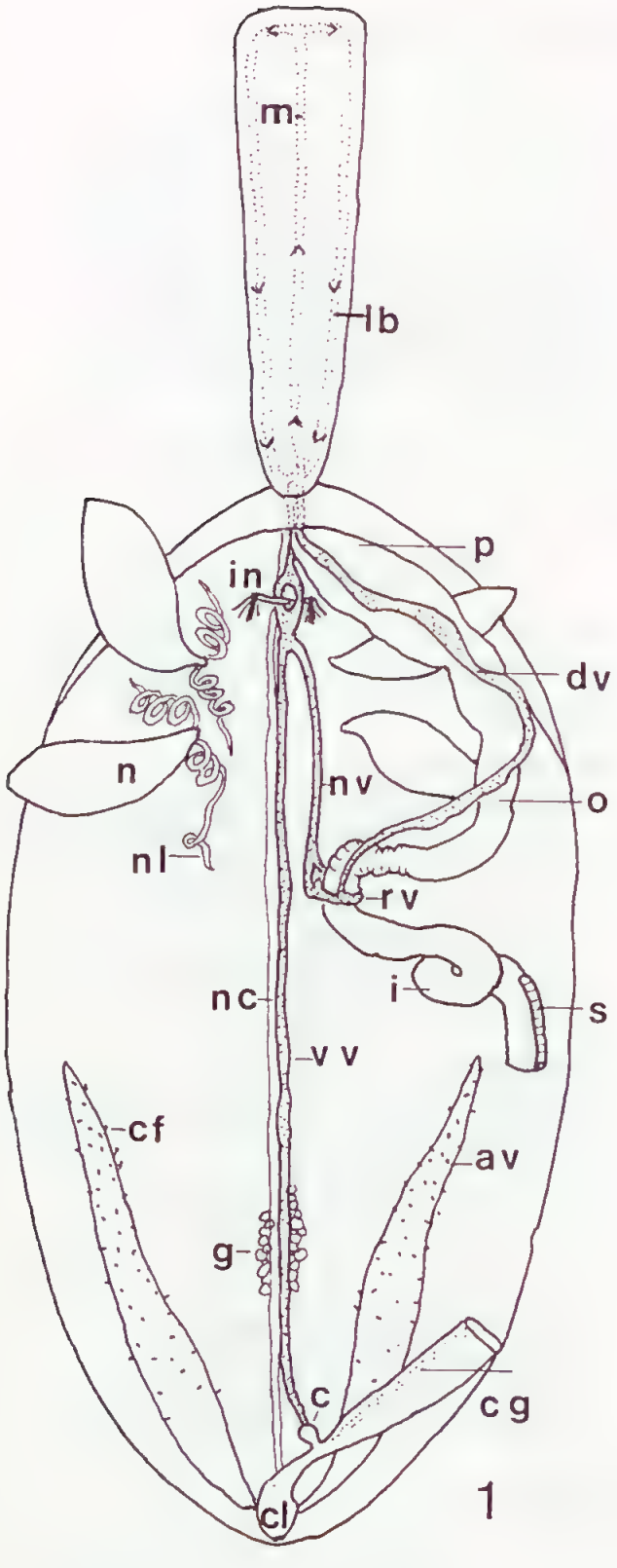


FIGURE 1. A generalized diagram to show some of the internal anatomy of an echiuran; dorsal view. Most of the much coiled intestine has been omitted. av, anal vesicle; c, caecum; cf, ciliated funnel; cg, ciliated groove; cl, cloaca; dv, dorsal vessel; g, gonad; i, intestine; in, interbasal muscle; lb, lateral vessel; m, median vessel; n, nephridia; nc, nerve cord; nl, nephrostomal lips; nv, neurointestinal vessel; o, oesophagus; p, pharynx; rv, ring vessel; s, siphon; vv, ventral vessel.

Key to Genera of Australian Echiurans

The doubtful genus *Archibonellia* has not been included in the key; it would key near *Pseudobonellia*.

1. Proboscis bifid 2
   Proboscis not bifid 3

2. One nephridium, with distally placed, stalked nephrostome ..... *Metabonellia*
   Two nephridia with a small sac carrying a male between them ..... *Pseudobonellia*

3. Longitudinal musculature of body wall grouped into bands 4
   Longitudinal musculature of body wall not grouped into bands 6

4. Nephridia less than 10 and arranged in pairs; trunk long or short 5
   Nephridia very numerous and not in pairs; trunk very long, up to 400 mm ..... *Ikeda*

5. Intervals between longitudinal muscle bands traversed by small bundles (fascicles) of oblique muscles ..... *Ochetostoma*
   Intervals between longitudinal muscle bands not traversed by small bundles of oblique muscles ..... *Listriolobus*

6. Nephrostome distal ..... *Vitjazema*
   Nephrostome basal 7

7. Ventral setae none 8
   Ventral setae two 9

8. Anal glands long and slender; posterior region of proboscis surrounded by a collar *Zenkevitchiola*
   Anal glands bushy or feathery; posterior region of proboscis modified to form a cup... *Sluiterina*

9. Nephrostomal lips long and spirally coiled..... ..... *Anelassorhynchus*
   Nephrostomal lips long or short but not spirally coiled 10

10. Anal glands tubular or sac-like 11
    Anal glands feathery or bushy .... *Protobonellia*

11. Proboscis with expanded or fan-like anterior extremity ..... *Arhynchite*
    Proboscis without expanded or fan-like anterior extremity ..... *Thalassema*

Description of Genera and Species

Genus **Metabonellia** Stephen & Edmonds

Metabonellia Stephen & Edmonds, 1972, p. 394.

Type-species: *Bonellia haswelli* Johnston & Tiegs, 1920. (*Bonellia gigas* Nielsen, 1963, which was named as type by Stephen & Edmonds (1972) is now

considered to be a junior synonym of *B. haswelli*). The genus contains only one known species.

Diagnosis

Female of medium to large size, with proboscis bifid, grooved and ciliated on ventral surface. Pale to dark green. Two ventral setae. Single nephridium with nephrostome on a short stalk placed about two thirds of way along nephridium towards its distal extremity. Anal vesicles branching. Intestinal siphon present. Male worm-like, as long as 20 mm and without setae. Found in nephridium of female.

Metabonellia haswelli (Johnston & Tiegs) (Figs 2–4, 18)

Bonellia haswelli Johnston & Tiegs, 1920, pp. 73–76; Edmonds, 1960, pp. 95–96.
Bonellia gigas Nielsen, 1963, pp. 61–67.
Bonellia tasmanica Dartnall, 1970, pp. 69–71.
Metabonellia haswelli Stephen & Edmonds, 1972, pp. 394–395; Dartnall 1976, pp. 1041–1043; Edmonds 1982, pp. 314–316.

Holotype: AMS G1122 and paratype G1261. Type locality, Sydney Harbour, N.S.W., 'under stones just above the limit of low water'.

Previous Australian records: Johnston & Tiegs (1920), Edmonds (1960), Nielsen (1963), Dartnall (1976).

Description of female

Trunk: Medium to large, shape variable (sausage to sub-ovoidal), light to dark green, length 20–80mm (Nielsen 1963: length 80–120mm, maximum width 40mm). Skin smooth to rough, usually covered anteriorly and posteriorly with near circular rows of rather flattened papillae. Thickness of body wall variable, longitudinal musculature continuous.

Proboscis: Firmly attached, long, bifid and capable of great extension, maximum length in fixed specimens 260 mm. Arms short and usually of about equal length, 20–30 mm. Lateral edges tend to roll inwards, ventral surface ciliate, dorsal surface smooth.

Setae: Two, together with reserve setae, ventrally placed and posterior to mouth. Setal but no interbasal muscle present

Alimentary Canal: Mouth at base of proboscis, canal much coiled and fastened to body wall by numerous strands of muscle. Consists of (1) foregut (divided into pharynx, oesophagus, crop and gizzard), (2) midgut (wider and longer than foregut), associated for most of its length with a collateral intestine or siphon and (3) hindgut and cloaca. Siphon tubular, of smaller diameter than intestine and arising near beginning of midgut. A ciliated groove lies in wall of much of posterior intestine. No precloacal caecum. Faecal matter forms pellets. Anus at posterior extremity of trunk.

Nephridium: Single, attached to coelomic wall of trunk just posterior to level of setae. Size variable, depending on reproductive condition of animal. Wall of anterior and posterior regions usually thicker than thin, often transparent, middle region, which seems capable of much extension and even sacculation. Nephrostome distal, situated about three-quarters to two-thirds length of nephridium away from nephridiopore. Nephrostomal lips frilled or crenated, situated at end of short stalk. Nephridium holds eggs and/or a male (two males in one specimen). Eggs develop in coelom along a mesentery associated with ventral blood vessel and nerve cord. Diameter of largest eggs 0.50–0.55 mm.

Vascular System: Thin walled ventral blood vessel. Single neurointestinal vessel, arising posteriorly from two short arms on each side of anteriormost region of intestinal siphon, joins ventral vessel in anterior half of trunk. Thin walled dorsal vessel fuses with intestine near posterior extremity of foregut. Anterior continuations of ventral and dorsal vessels extend into proboscis. Neurointestinal vessel often vesiculated or superficially roughened and coloured dark yellow to orange.

Anal Vesicles: Two, much branched, tufted and each a complex of tubes and tubules. Johnston & Tiegs (1920, p. 75) described them thus: 'Into the cloaca open two anal vesicles .... Into each open about 15 tubules, some quite short, others much longer. These tubes give off smaller or larger numbers, at times very large numbers, of secondary nephridial [? excretory] tubes, each ending in a narrow neck which bears a circular disc with the nephrostome opening in its centre. The disc is composed of a ring of compressed elongated cells, with strongly staining nuclei and fringed with a ring of cilia'. In larger specimens the vesicles are larger and the branches more tufted.

Description of male (based on four stained and mounted specimens)

Located in nephridia of females but not permanently attached like male of *Pseudobonellia biuterina*. Long, thin or flat but swollen or rounded anteriorly, tending to taper posteriorly; largest about 20 mm long, maximum width 1.2, lacking setae. Body wall very thin. Outline of what might be a rudimentary gut runs through most of animal; body cavity contains developing sperm morulae. Cilia on some regions of body surface.

No males were found by Johnston & Tiegs (1920). The male of *Bonellia gigas* Nielsen, 1963 is 19 mm long and 0.5–1.0mm wide, lacking setae but

possessing a posterior sucker or clasper. The male of *Bonellia tasmanica* Dartnall, 1970 is 7 mm long, 0.8 mm wide, tapering posteriorly and lacking both setae and clasper.

Systematics

Bonellia gigas Nielsen, 1963, described from a very large bonelliid collected at Western Port, Vic., was considered to be different from *B. haswelli* chiefly because it lacked an intestinal siphon. Although I have not been able to dissect the type of *B. gigas*, I have dissected one specimen from Port Phillip Bay and another from Flinders. Both have siphons. Further, Fig. 2 of Nielsen, 1963, clearly shows a siphon attached to part of the gut, especially the posterior part. Nielsen apparently mistook the siphon for a continuation of the neurointestinal vessel and labelled it 'intestinal blood vessel'.

Dartnall (1970) described *B. tasmanica* from northern Tasmania, arguing that it differed from *B. haswelli* because it lacked a siphon and from both *B. haswelli* and *B. gigas* because its nephridia were sacculated. It is probable that what Dartnall described as 'an intestinal vessel, which runs closely along the wall of the intestine for about the posterior two thirds of its length' and then 'leaves the gut and joins the ventral vessel' is in part a siphon and in part a neurointestinal vessel. The sacculated condition of the nephridium of *B. tasmanica* is a doubtful character and was probably caused by temporary muscular contractions of the organ at the time of fixation. In one specimen from S.A. the thin walled part of the nephridium is constricted near its middle so as to form two sacs.

From a study of male and female specimens of *B. haswelli, B. gigas* and *B. tasmanica* it is concluded that the three species are synonymous, the first name having priority. Stephen & Edmonds (1972) transferred the species to a new genus *Metabonellia* on account of the distal position of its nephrostome. Johnston & Tiegs' specimens from N.S.W. were small but Nielsen's from Victoria were very large.

Specimens examined and localities

New South Wales: Fairlight (near Manly) (1) AMS W5612 and (3) AMS W4702 (two of these clearly show the relationship between the neurointestinal vessel and the siphon); Camp Cove, Sydney Harbour (1) AMS W8703; locality unknown (1) SAM E1404.

Victoria: Port Phillip Bay near Port Arlington (2) MV coll. and at Mornington (1) MV coll; Flinders, Western Port Bay, SAM E1400 (1) and type male and female of *B. gigas* MV G2696 and 2697; Port Phillip Survey area 31 'inside buoy' (1) SAM E1407.

Tasmania: Jacobs Boat Harbour (north Tasmania), paratype of *B. tasmanica*, TM K226.

South Australia: Spencer Gulf – Boston I. (near Port Lincoln) (2) SAM E1401; at following islands in Banks Group, Marum I. (3) SAM E1475, (3) SAM E1492, Lusby I. (1) SAM E1488, Langton I. (1) SAM E1504, Hareby I. (1) SAM E1508; St Vincent Gulf – Edithburg jetty (near base of outer piles) (2) SAM E1403, (1) SAM E1457, (3) SAM 1458 (3) SAM E1502; Marino Rocks (3) SAM E1406; Aldinga Reef (1) SAM E1402; Victor Harbour – near Rosetta Head (3) SAM E1451, (3) SAM E1483, (3) SAM E1466, (5) SAM E1451, (3) SAM E1490 and near Whalers Wharf (3) SAM E1474; St Francis I. (Nuyts Archipelago) (4) SAM 1469.

Western Australia: Mistaken I. (King George Sound) (1) WAM 37–85; Garden I. (1) WAM 10–73; off Carnac I. (1) WAM 71–75; off Dunsborough (1) WAM 9–73; Houtman Abrolhos (At N. end of Morley I., Easter Group) (1) WAM 279–85.

Distribution

Known from south-western, southern and south-eastern Australia, from the Abrolhos I. in Western Australia to Sydney Harbour in New South Wales. Usually collected subtidally, occasionally intertidally. No records other than from Australia.

Habitat

'In South Australia individuals of this species live in crevices between rocks and under rocks in sheltered, calmer water where there is a deposition of fine, muddy silts, such as occurs on the lee side of the Bluff at Victor Harbour and at Edithburg jetty on Yorke Peninsula. The greatest concentration appears to be at the perimeter of the rubble-reef area, especially where the latter abuts open flat where sea-grasses grow. The proboscis extends only at night and then over the bottom adjacent to the burrow for a radius of about one metre' (N. Holmes pers. comm.).

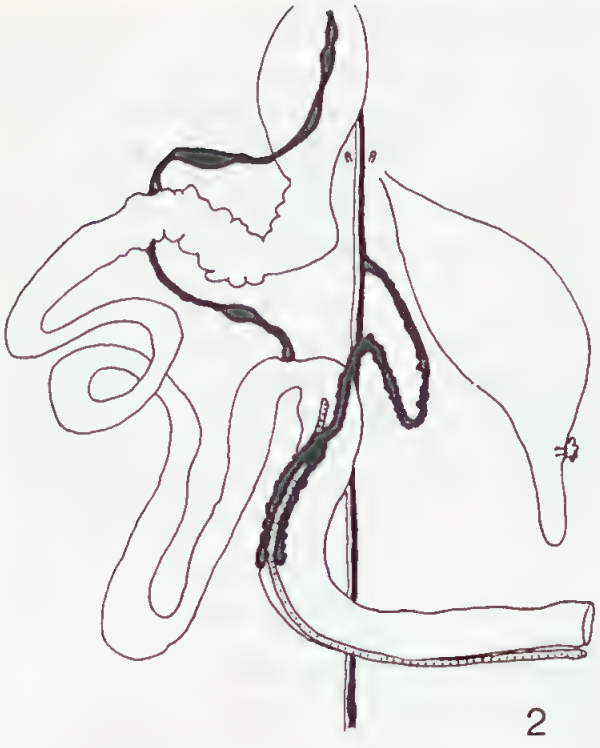
Genus **Pseudobonellia** Johnston & Tiegs

Pseudobonellia Johnston & Tiegs, 1919, pp. 213–230; Stephen & Edmonds, 1972, p. 401; Datta Gupta 1976, p. 115.

Type-species: *Pseudobonellia buiterina* Johnston & Tiegs

Diagnosis

Female with bifid proboscis. Trunk with two ventral setae. Two nephridia (gonoducts) with distally placed nephrostomes; nephrostomal lips crenated. Anal vesicles branching. Male carried in small blind tube that projects into coelom between nephridiopores. Type species: *Pseudobonellia*



FIGURES 2–4. *Metabonellia haswelli*. 2, anterior region dissected. 3, seta (scale line = 0.3 mm). 4, portion of anal vesicle.

biuterina Johnston & Tiegs, 1919. The genus contains only one species.

Pseudobonellia biuterina Johnston & Tiegs (Figs 5–8, 19)

Pseudobonellia biuterina Johnston & Tiegs, 1919, pp. 213–230, pls 9–11; Monro 1931, p. 33; Fisher 1948a, p. 856; Edmonds 1960, pp. 96–97, fig. 5; Stephen & Edmonds 1972, p. 401.
Archibonellia mjoebergi Fischer, 1921, pp. 6–8; *Austrobonellia mjoebergi* Fisher, 1948a, 856; Edmonds 1960, p. 97.

Holotype: AMS G477: type locality, North West Islet (Capricorn Group), Qu.

Description of female

Trunk: Small, maximum length 23 mm (mostly 6–14), maximum width 3–6, pyriform, sub-ovoidal to globular, pale to dark green. Body wall thin (sometimes transparent) except in anterior and posterior region, usually thinnest on dorsal side. Surface usually wrinkled by large numbers of closely set papillae. Nephridiopores and opening of male tube on anterio-ventral surface often very noticeable.

Proboscis: Long, bifid, adherent and capable of much extension; in fixed specimens 1–10 times as long as trunk. Arms shorter (3–10 mm), normally about equal length. Ventral surface ciliated, lateral edges tending to curve inwards. Mouth at base of proboscis.

Setae: Two (in addition smaller reserve setae usually present), golden brown, slightly iridescent, with free end forming a weak hook. Johnston and Tiegs state that larger hooks are 2–3 mm long and smaller 0.7–0.8 mm and that a strong muscle pad joins their internal ends 'evidently serving to impart to them a lateral pincer-like movement'. The description aptly fits the structure and function of an interbasal muscle. Although there are well developed setal muscles in the present specimens, none clearly show the presence of an interbasal muscle.

Nephridia (gonoducts or uteri): One pair, size variable, usually prominent, tapering distally, each with a slightly frilled, distally placed nephrostome borne on a short stalk. Largest eggs in nephridium 0.25–0.35 mm (Johnston & Tiegs 1919 give 0.11 mm). Nephridiopores on each side of nerve cord in anterior trunk region.

Male tube (androecium): Small, 1.5–3.0 mm long, opening externally near nerve cord at about level of nephridiopores. Opening often very noticeable. Tube encloses small, wormlike male attached to distal end of tube.

Alimentary Canal: Foregut short; midgut long, thin walled and associated for much of its length with an intestinal siphon; hindgut short. No precloacal caecum. Faeces form sub-ellipsoidal pellets.

Vascular System: Thin walled ventral vessel runs alongside of nerve cord. Thin walled dorsal blood vessel (fastened to foregut and body wall by mesenteries) fuses with gut near junction of fore- and mid-gut. Single neurointestinal vessel, arising from wall of midgut just posterior to anteriomost extremity of siphon, joins ventral vessel in anterior half of trunk. Intestinal extremity of neurointestinal vessel usually arises from two short roots which lie on each side of the siphon and in close contact with it. Neurointestinal vessel sometimes vesiculated.

Anal Vesicles: Two branching, tuft-like masses of fine tubes, arising on each side of posteriormost section of hindgut. In this respect they differ from the type description in which 'each anal tree consists of masses of very delicate, simple, cylindrical tubes opening separately into the rectum'. Edmonds (1960, p. 96) remarked that 'the anal vesicles do not seem to communicate with the cloaca as simply as described by Johnston and Tiegs' and that the tubes branch to some extent. The anal vesicles of dissected specimens in the present collection from Queensland and Western Australia are branched. In one of the paratypes (AMS G477), the vesicles arise from about 12 short tubes which branch and sometimes rebranch into simple cylindrical tubules that open to the coelom through slightly dilated funnels fringed with cilia.

Ovaries: Johnston & Tiegs (1919) state that the ovaries arise from the peritoneum lining the muscular strands that hold the posterior portion of the rectum in position and that they lie transversally on the frenulae. In the present specimens developing eggs lie more longitudinally in the posterior third or half of the body cavity in close association with the ventral vessel.

Description of male

According to Johnston & Tiegs (1919) the male lives permanently in the androecium of the female, the two being fused distally. Without definite mouth or anus, although a rudimentary canal is present. No setae. Two seminal vesicles present. How the male performs its sexual function is not known. Johnston & Tiegs (1919) suggest that 'the sperms may be liberated into the cavity of the androecium whence they reach the exterior through its canal and enter the adjacent openings. It is possible, however, that the male may be protruded through the canal of the androecium and actually liberate sperms in the female aperture'.

Systematics

Although the specimens examined in the present collection from North West I. and Heron I. differ in a few respects from the type description, they are considered to be *P. biuterina*.

No satisfactory character has been found that distinguishes any of the Western Australian bonelliids from *P. biuterina*. Those collected from the CSIRO laboratory at Waterman Bay (from under pots standing on sand in an indoor aquarium through which sea water was continually passed) were pale green while those collected at Heron I. were dark green. How important colour differences are is not known. Agius & Jaccarini (1981) have shown that the unpigmented trochophores of *Bonellia viridis* when kept under constant illumination develop into unpigmented adults. Whether the depth of colour of *P. biuterina* depends on the amount of light received is unknown.

Two other bonelliids closely related to *P. biuterina* have been described from W.A., *Archibonellia michaelseni* Fischer, 1919 and *Austrobonellia mjoebergi* (Fischer, 1921), the former from Rottnest I., the latter from Broome, both localities being places where *P. biuterina* has been found. Both Fischer's species were described from single specimens.

Austrobonellia mjoebergi Fischer, 1921, is now being placed in the synonymy of *P. biuterina* Johnston & Tiegs, 1919. Fischer described his specimen thus; trunk oval, 45 mm long, light grey and transparent; proboscis short, 18 mm long, with two arms of unequal length. Setae two with recurved tip, no interbasal muscle. Nephridia two, thin walled (containing eggs) with distally placed nephrostomes and a median, unpaired, smaller, thick-walled 'Segmentalorgan' or 'Uterus', with a basally placed nephrostome. Intestine long and convoluted. Anal vesicle disc-like and expanded with 12–15 dentritic main stems the branches of which possess lateral funnels.

If Fischer's 'Segmentalorgan' is a male tube and if injury accounts for the inequality in the length of the proboscis arms, then the description of *A. mjoebergi* fits very well that of *P. biuterina*. Fischer's other specimen from W.A., *Austrobonellia michaelseni*, differs in other characters and is possibly a separate species.

Specimens examined and localities (these are additional to those recorded in Edmonds, 1960)

Queensland: Heron I. (1) AMS W3719; North West I. (3) AMS W1807, (1) AMS W2691; Whitsunday Group (1) AMS W3029; One Tree I. (1) AMS W9275

Western Australia: Barrow I. (2) WAM 139–81; Riddell Pt, Broome (3) WAM 50–85; Roebuck Bay, Broome (2) WAM 47–85; Abrolhos I. (1) WAM 102–79; Yanchep Reef (2) WAM 98–79; Waterman Bay (CSIRO Marine Laboratory) (10) SAM E1439–1441; Garden I. (1) AMS W3720; Albany (S. side of Princess Royal Harbour) (2) WAM 147–81; Lookout Pt, Cheyne Bay (1) SAM E1482.

Distribution

Queensland: The Great Barrier Reef, from

Capricorn Group in the south to Low I. in the north.

Western Australia: From Barrow I. in the north to Cheyne Bay in the south. Whether the species extends from Queensland to Western Australia through Torres St is not known. It is not known from S.A., Vic., N.S.W. or Tas.

Other record: New Caledonia (Stephen 1976).

Habitat

Specimens have been collected intertidally in coral and limestone reefs; also from under stones and objects resting on sand.

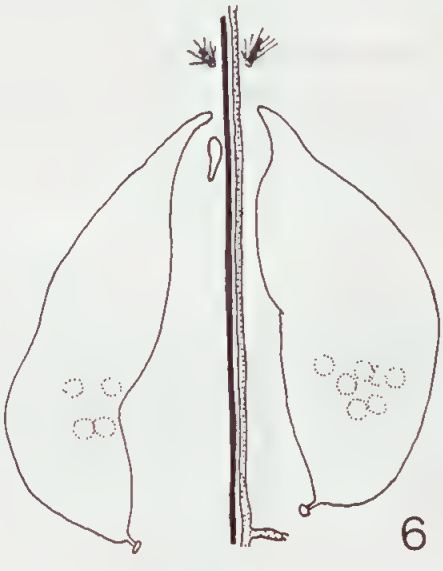
Genus **Archibonellia** Fischer

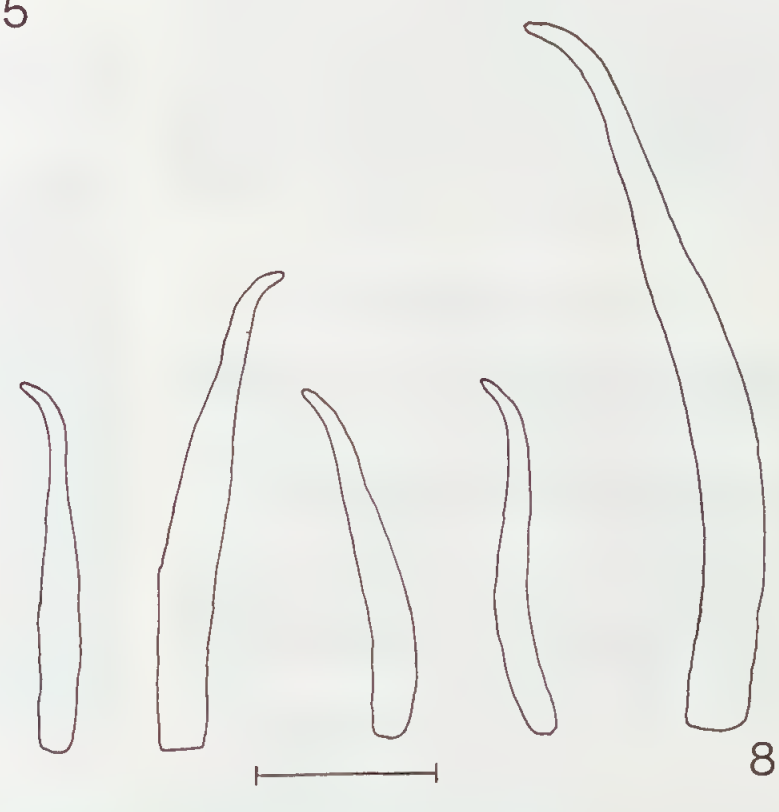
Archibonellia Fischer, 1919, p. 283; Fisher 1984a, p. 856.

Type-species: *Archibonellia michaelseni* Fischer, 1919.

Diagnosis

Female with bifid proboscis. Trunk with two ventral setae. Three nephridia, two being paired, lateral and very small and the third median, large and unpaired. Position of nephrostome not known. Intestine very short with globular caecum. Male not described.





FIGURES 5-8. *Pseudobonellia biuterina*. 5, anterior region, digestive and vascular systems; 6, nephridia (gonoducts) and male tube; 7, small portion of anal vesicle; 8, setae from different specimens (scale line = 0.5 mm).

?* *Archibonellia michaelseni* Fischer

Archibonellia michaelseni Fischer, 1919, pp. 283–285; 1926, p. 207; Fisher 1948a, p. 856; Edmonds 1960, p. 97.

Type-specimen: Not known; type locality: west coast of Rottnest I., near Fremantle, W.A.

Description of female (after Fischer 1919) (Male not known)

Trunk: About 12 mm long, grey in life. Proboscis anteriorly forms two lappets. Setae two, with reserve pair and an interbasal muscle. Two small, paired nephridia ('Segmentalorgane') placed below a large unpaired 'Uterus'. Intestine very short, consisting of a single loop in anterior half of trunk and a bow-shaped tubular part in posterior half. Globular caecum present. Ovary lies along posterior region of nerve cord. Anal vesicles arise as single stems an either side of rectum and branch at tip. Position of nephrostome not known.

Systematics

A. michaelseni resembles *P. biuterina* Johnston & Tiegs in many respects, especially in the possession of an unpaired, median 'Uterus' lying between paired lateral nephridia. Moreover, Fischer (1919) thought that he saw a male in the median structure. In *P. biuterina*, however, (1) the lateral nephridia are much larger than the medial tube; (2) the alimentary canal is very long and convoluted and not very short (incredibly short) as shown in Fischer 1919, fig. 6; and (3) neither caecum nor interbasal muscle is present. While the two species may be synonymous the described differences between them are considerable and until the type or more specimens became available it is probably best to consider them as different.

Genus **Protobonellia** Ikeda

Protobonellia Ikeda, 1908, p. 259; Fisher 1948a, p. 854; Datta Gupta 1976, p.115.

Type-species: *Protobonellia mitsukurii* Ikeda, 1908.

Diagnosis

Proboscis of female long, tubular, non-bifid. Ventral setae two. One nephridium. Nephrostome stalked, fimbriated, basal. Anal vesicles long, dentritic. Male not known.

* *Protobonellia papillosa* Murina

Protobonellia papillosa Murina 1978, pp. 112–113, fig. 4.

Description (after Murina, 1978)

Trunk 28 mm long, 16 mm wide, bearing rounded papillae 0.25–1.25 mm in diameter, densest anteriorly and posteriorly. Proboscis light grey, width 5.5 mm, distally blunted; basal part (near mouth) has form of oval collar with thick, wavy, pigmented borders and two long processes laterally. Setae two, golden-yellow, bent or curved, 0.5 mm long, 0.15 wide. Nephridium single, rounded, lying on right side of nerve cord; nephrostome short, basal. Anal vesicles form dense bushes on each side of rectum. No clearly visible anal rosette.

Specimen and locality

Described from one female specimen collected during cruise of 'Dmitrii Mendeleef', Stn 1245, 30° 24' S, 161° 57' E near Lord Howe I. at 1200 m. No other record.

Genus **Sluiterina** Monro

Sluiterina Monro, 1927, p. 618; Murina 1976, p. 840.

Type-species: *Hamingia sibogae* Sluiter, 1902.

Diagnosis

Proboscis of female non-bifid; lateral edges turn inwards giving structure a tubular appearance; edges fuse near mouth to form a cup. Nephridium single, nephrostome basal. Anal vesicles bushy or brush-like. Male unknown.

* *Sluiterina alba* Murina

Sluiterina alba Murina, 1978, p. 111, fig. 3.

Description (after Murina 1978)

Trunk 44 mm long, 8 mm wide, posterior region damaged. Body wall white, thick and not transparent. Proboscis 12 mm long, 6 mm wide (distal part damaged), with lateral margins folded inwards making it tubular in form. Nephridium single, sac-like, 7 mm long, 3 mm wide, with centrally located nephrostome. About 50 white eggs with diameter 0.12–0.13 mm in cavity of body. Between posterior coils of gut are bunches of bright yellow material, probably remains of anal vesicles.

Specimen and locality

Described from a single female collected during cruise of 'Dmitrii Mendeleef', Stn. 1373, Great Australian Bight, 33° 48' S, 127°07' E at 1080–1100 m. No other record.

Genus **Vitjazema** Zenkevitch

Vitjazema Zenkevitch, 1958, p. 195; Datta Gupta 1976, p. 115.

Type-species: *Vitjazema ultraabyssalis* Zenkevitch, 1958.

Diagnosis

Probosics of female non-bifid; anterior region, however, expanded into a slightly widened 'head' with thickened festoons along anterior border; under festoons are triangular flaps directed inside a ventral gutter. Setae two. Nephridia two, nephrostome distal. Anal vesicles sac-like. No male known.

* *Vitjazema ultraabyssalis* Zenkevitch

Vitjazema ultraabyssalis Zenkevitch, 1958, pp. 195–197, fig. 3; Murina 1978, p. 115.

Description

Trunk green, length 14–15 mm. Proboscis 9-27mm long with deep funnel on ventral side; anterior region widened with festoon-like border consisting of 5–6 triangular lappets. Setae 2, large with bent blades and blunt tips. Nephridia one pair, with distal nephrostomes at end of long tube. Anal vesicles unbranched, covered with small funnels.

Specimens and localities

Two female specimens collected during cruise of 'Dmitrii Mendeleef', Stn 1365, Great Australian Bight, 34° 25'S, 128° 12' 5"E at 3880 m.

Distribution

Kurile – Kamchatka Trench (at 5560–9700 m); Marianne Trench; Great Australian Bight (at 3880 m).

Genus **Zenkevitchiola** Murina

Zenkevitchiola Murina, 1978, p. 108.

Type-species: *Zenkevitchiola brevirostris* Murina, 1978.

Diagnosis

Proboscis long, non-bifid. Trunk without setae. Single nephridium, nephrostome basal. Anal vesicles, two, long, slender, filamentous. Male not known.

* *Zenkevitchiola brevirostris* Murina

Zenkevitchiola brevirostris Murina, 1978, pp. 108–109, fig. 1.

Description (after Murina, 1978)

Trunk 68 mm long, 28 mm wide, anterior third and posterior quarter covered with low, rounded papillae 1.5 x 0.8 mm. Coils of gut visible through body wall. Proboscis white, transparent with lateral margins turned up or folded, length 65 mm, width 5–7 mm; distal extremity curved and widened, proximal extremity forms cup with a slit on ventral side. Nephridium single, 11mm long, 5mm wide, located on right side of nerve cord; anterior region swollen and filled with eggs 0.25–0.3 mm in diameter, posterior half with thicker walls and no eggs. Nephrostome basal, stalked and with rosette at distal end. Anal vesicles two, dark brown, tapering distally. Gut coils 10–12. Anus forms weak rosette, surrounded with small papillae.

Specimen and locality

Described from one female collected during voyage of 'Dmitrii Mendeleef', Stn 1345, near southern Tasmania, 43° 47'5" S, 147° 51' E at 755 m. No other record.

Genus **Anelassorhynchus** Annandale

Anelassorhynchus Annandale, 1922, p. 148; Fisher 1946, pp. 221–22; 1949, pp. 480–481; Stephen & Edmonds 1972, pp. 443–444.

Type-species: *Thalassema branchiorhynchus* Annandale & Kemp, 1922.

Diagnosis

Proboscis well developed, usually long, never bifid. One pair of ventral setae. Longitudinal, circular and oblique musculature of body wall continuous. Nephridia, 1–3 pairs. Nephrostomal lips long and spirally coiled (thus differing from genus *Thalassema*).

Key to Australian Species of *Anelassorhynchus*

1. Nephridia, two pairs and post-setal 2
   Nephridia, three pairs and post-setal... *A. vegrandis*

2. Trunk globular to ovoidal, sandy-grey to light brown in colour ..... *A. porcellus porcellus*
   Trunk sausage-shaped to elongate, green in colour ..... *A. porcellus adelaidensis*

Anelassorhynchus vegrandis (Lampert)

Thaslassema vegrande Lampert, 1883, p. 341; Monro 1932, p. 33.
Anelassorhynchus vegrandis Fisher, 1946, p. 222; 1949, p. 481.

Type-locality: Philippines.

Description (after Lampert 1883)

Proboscis lacking. Nephridia three pairs and post-setal. Nephrostomal lips spirally coiled. Anal vesicles long and without ciliated funnels.

Remarks

Monro's specimen from the Barrier Reef was in poor condition and his identification was made with some reservation. The species is not well known.

Anelassorhynchus porcellus porcellus Fisher (Fig. 20)

Anelassorhynchus porcellus Fisher, 1948b, pp. 274–277, figs 1a–d; Edmonds 1960, pp. 91–92, pl. 1c.

Type-specimen: U.S. Nat. Mus., Washington D.C.. Type-locality, Honolulu, on reef south of harbour.

Description

Trunk: Globular to ovoidal, colour sandy grey to light brown, length 25–40 mm, maximum width 15–29 mm; skin rather thick but wrinkled with numerous flat papillae; musculature continuous. Setae two, golden-brown, lying posterior to mouth; no interbasal muscle present.

Proboscis: Fleshy, readily deciduate, usually tapering anteriorly, 8–20 mm long.

Alimentary Canal: Very long and fragile, filled with fragments of coral, small shells and coral sand (which usually rupture the thin gut wall as soon as one tries to free the intestinal coils); presiphonal section of mid-gut very long.

Vascular System: Consists of dorsal vessel, ring vessel, two neuro-intestinal vessels and a ventral vessel.

Setae: Two pairs, post-setal, with nephrostomal lips long, slender and coiled.

Anal Vesicles: Two long, with small, unstalked funnels. Intestinal siphon present but no precloacal caecum.

Systematics

The specimens from Heron I. correspond closely with two of Fisher's specimens of *A. porcellus* from Kakaoha Reef, Hawaii (U.S. Nat. Mus. part 26423). Fisher was unable to recognise any ciliate funnels on the anal vesicles of his specimens. In the Australian specimens the funnels, though small and sparse, are definitely present. One of Fisher's specimens when dissected was found to possess three pairs of nephridia.

Specimens Examined

Qu: Heron I. (Capricorn Group) (3) SAM E1425; North-West I., (Capricorn Group) (1) AMS W2816; Ingram I. (1) SAM E1431; Brockhurst Reef off Townsville (1) SAM E1494.

Distribution

Western Pacific Ocean at Hawaii and Great Barrier Reef, Qu.

Anelassorhynchus porcellus adelaidensis Edmonds n. stat. (Figs 9–11, 21)

Anelassorhynchus adelaidensis Edmonds, 1960, pp. 92–93, pl. 2a.

Anelassorhynchus porcellus (in part) Edmonds, 1982, p. 316.

Type-specimen: AMS; type locality Aldinga Beach, S.A.

Description

A number of specimens which have previously been called *A. adelaidensis* and *A. porcellus* (in part) are now being referred to as a new subspecies, *A. porcellus adelaidensis*. The new subspecies differs from the nominate form in size, colour and distribution.

Trunk: More elongate than nominate subspecies, length 15–90 mm, maximum width 10–40 mm, always light to dark green, surface wrinkled and made verrucose by many, large, flat, white papillae (most numerous anteriorly and posteriorly); secretes copious amounts of mucus making animal very slippery to hold.

Proboscis: Fleshy, readily deciduate, up to 37 mm long, lateral edges may be wavy but never with processes.

Setae: Two golden brown, 2.8–5 mm long, no interbasal muscle (setae lost in some specimens).

Nephridia: Two post-setal pairs (occasionally an extra single nephridium or pair); nephrostomal lips filamentous, weakly to strongly coiled.

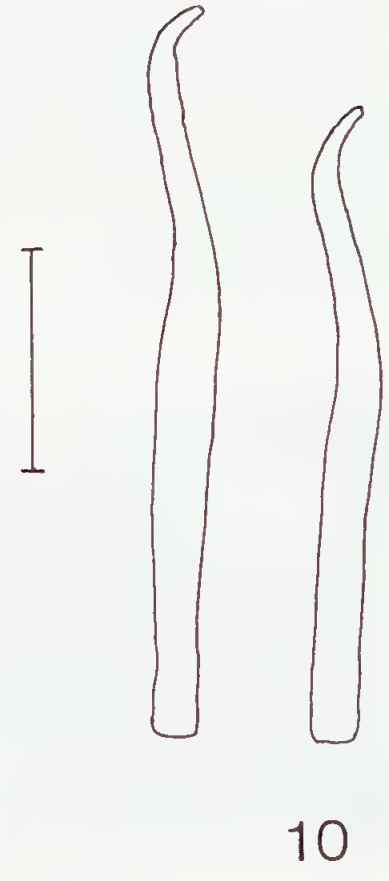
Alimentary Canal: Very long and much convoluted, with very long presiphonal section of mid-gut; faecal matter not in form of pellets; intestinal siphon present but no caecum.

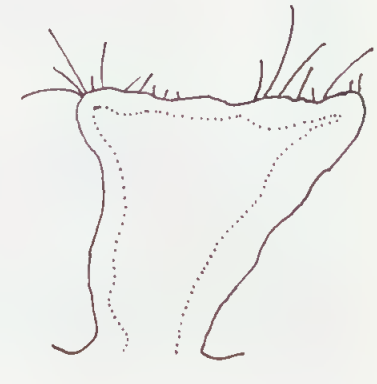
Anal Vesicles: Two, long, thin walled, tubular but usually expanded basally, and attached (especially basally) to body wall by numerous mesenteries or muscles; coelomic surface bears sparsely distributed ciliate funnels and numerous brown spots which appear to be aggregates of very small pigmented granules.

Vascular system: Dorsal, ring, two neurointestinal- and ventral vessels. Hand cut sections of proboscis show two lateral and one median vessel. Well-developed ventral nerve cord extending into proboscis.

Specimens and localities

Victoria: Port Phillip Bay, SAM E1429, Brighton. SAM E1432.





FIGURES 9–11. *Anelassorhynchus porcellus adelaidensis*. 9, dissected specimen; 10, setae (scale line = 1.0 mm); 11, ciliated cup from anal vesicle.

South Australia: St Vincent Gulf–Port Willunga, SAM E1427 (1); Aldinga Reef, SAM E1428 (1); Cape Jervis, SAM E1430 (1); Coobowie, SAM E1454 (1), SAM E1455 (1), SAM E1456 (5), SAM E1461 (3), SAM E1462 (1); Brighton, SAM E1463 (5). Spencer Gulf–at following islands at Banks Group, Winceby I., SAM E1476 (3), Marum I., SAM E1477 (2), SAM E1486 (1), SAM E1493 (3), Lusby I., SAM E1489 (3). Eyre Peninsula–Port Lincoln, SAM E1479 (2); Port Turton Jetty, SAM E1503 (1); Venus Bay (under jetty), Blanche Pt (Streaky Bay), Smokey Bay, (coll. K. Gowlett-Holmes).

Systematics

The internal anatomy of the South Australian specimens corresponds very closely with that of *A. porcellus*. Their shape, however, is more elongate and their colour green. Fisher does not mention the colour of his specimens but specimens of *A. porcellus* collected by the author at Heron I., Qu., were light brown to sandy grey. The green subspecies is commonly collected by divers in S.A. but no brown forms have yet been found in the State. The distribution of the two subspecies consequently seems different. *A. gangae* Bisewar, 1984, recently described from Natal, South Africa and *A. porcellus adelaidensis* are closely related species.

Distribution

Southern Australia from Port Phillip Bay (Vic.) to Streaky Bay (Eyre Peninsula) in S.A.

Genus **Arhynchite** Sato

Arhynchite Sato, 1937, pp. 142–143; Fisher 1946, p. 485; Stephen & Edmonds 1972, p. 414.

Type-species: *Thalassema arhynchite* Ikeda.

Diagnosis

Proboscis long slender, often ribbon-like, sometimes deciduate; anterior extremity expanded into a fan-like structure. Two ventral setae with strong interbasal muscles. Nephridia two, with nephrostomal lips expanded into a leaf-like structure. Anal vesicles long, thin walled and unbranching. Vascular system with or without ring vessel.

Arhynchite hiscocki Edmonds

Arhynchite hiscocki Edmonds, 1960, pp. 90–91, fig. 3, pl. 1, fig. 1b; 1966, p. 178; Stephen & Edmonds 1972, p. 417.

Holotype: AMS W3714; type locality: Dunwich, Qu., 'dug from sand pit, 18" below surface'.

Description

Trunk: Elongate, slender, pencil-like, length 100–120 mm, width 4–6 mm, fixed specimens yellow-brown to grey green. Surface made verrucose by numerous near rows of elevated papillae, slightly larger at anterior and posterior extremities. Musculature continuous.

Proboscis: Delicate, slender, about 30 mm long, 1.5–2.5 mm wide, still attached to trunk in holotype; anterior extremity flattened and fan-like. In one specimen from Victoria proboscis is shorter, deciduate, with anterior extremity more spoon-like.

Setae: Two, connected to body wall internally by strong radiating muscles and to each other by strong interbasal muscle.

Nephridia: Two, sub-cylindrical, slender, length variable; post-setal. Nephrostome basal was expanded, frilled or leaf-like lip.

Alimentary Canal: Midgut with siphon; no precloacal caecum.

Vascular System: Dorsal blood vessel fuses with foregut at posterior extremity of latter; neurointestinal vessel connects with anterior section of midgut near anterior extremity of siphon. No ring vessel observed.

Anal Vesicles: Two, very slender, brown, about one third to a quarter as long as trunk, fastened throughout their length to posterior region of alimentary canal but to body wall over last quarter of their length. Numerous ciliated funnels scattered over their surface.

Systematics

Sato (1937) erected the genus *Arhynchite* for a group of echiurans lacking a proboscis. Fisher (1949), having found two species possessing a long deciduate proboscis, redescribed the genus. The proboscis of the holotype of *A. hiscocki* is still attached but that of one of the Victorian specimens is detached.

The genus contains six species collected from places bordering the Pacific Ocean; *A. californicus* –Monterey (U.S.A.), *A. inamoenus* – Monterey (U.S.A.), *A. pugettensis* Puget Sound (U.S.A.), *A. rugosus* –Shantung (China), *A. arhynchite* –Japan. Some of the species are closely related and difficult to distinguish. *A. hiscocki* is not a well known species and needs re-examination and revision when more species are found.

Specimens and localities

Queensland: Stradbroke I. (Edmonds 1960), AMS W3714 (2)

Victoria: Port Phillip Bay (Edmonds 1966) VM coll. (2)

South Australia: Spencer Gulf, north of Port Lowly, SAM E1524 (1).

Genus **Listriolobus** Spengel

Listriolobus Spengel, 1912, p. 316; Fischer 1926, p. 110; Fisher 1946, p. 233.

Type-species: *Listriolobus bahamensis* (Fischer), (designated by Fisher 1946).

Diagnosis

Proboscis of variable length, truncate but never bifid. Two setae with interbasal muscle. Longitudinal musculature of trunk wall grouped into bands (not always well developed in young specimens). Oblique musculature not banded or fasciculated as in *Ochetostoma*. Nephridia two to three pairs, nephrostomal lips long and spirally coiled. Anal vesicles sac-like to tubular and without branches.

Key to Australian Species of *Listriolobus*

1. Longitudinal musculature in 7 bands *L. brevirostris*
   Longitudinal musculature in 13 bands *L. sorbillans*

?* ***Listriolobus sorbillans*** (Lampert)

Thalassema sorbillans Lampert, 1883, pp. 340–341; Augener 1903, p. 349.
Listriolobus sorbillans Fisher, 1946, p. 234.

Type-locality: Philippines.

Australian record: Sydney (coll. Dr Schutte, 1876) in Augener 1903, p. 349.

Description (after Lampert 1883)

According to the type description (based on a single specimen) the trunk is 65 mm long and proboscis 24. Longitudinal musculature in 13 bands. Nephridia three pairs with spirally coiled nephrostomal lips, first pair presetal in position. Setae small. Anal vesicles long, brown, bearing microscopic ciliate funnels. Small rectal caecum.

Augener's description of his single specimen is brief. Trunk about 42 mm long, proboscis 18 mm. Whole body covered with papillae which are smallest in mid-trunk and largest posteriorly. Anal vesicles about two-thirds length of trunk.

Remarks

This Australian record needs confirmation. If the oblique musculature of Augener's specimen was fasciculated then it might have been *Ochetostoma australiense*.

Listriolobus brevirostris Chen & Yeh Chen-Chang (Figs 12–13, 22)

Listriolobus brevirostris Chen & Yeh Chen-Chang, 1958, pp. 273–278, fig. 7 A-D; Stephen and Edmonds 1972, p. 424.
Listriolobus bulbocaudatus Edmonds, 1963, pp. 243–244, pl. 1, fig. 1.

Type-locality: Kiao-chow Bay, Shantung, China.

Description

Trunk: Sub-cylindrical to cigar shaped, length 21-85 mm, maximum width 10–20 mm, fixed specimens light to dark pink. Surface covered with white papillae, lying almost in rows. Posterior extremity may sometimes be modified and expanded into a fleshy, bulbous, conical structure bearing three or four rows of prominent, pointed or mamillate, white or pink papillae. Longitudinal musculature arranged in bundles, often difficult to discern externally. Dissected specimens show seven (eight in one specimen) well spaced longitudinal bands, occasionally weakly developed where the body wall is thin. Oblique musculature between bands of longitudinal musculature continuous and not in fascicles.

Proboscis: Non-deciduate in all specimens. In fixed condition short, stout, 10–16 mm long, 6–12 mm wide. Small papillae on dorsal surface. Lateral margins wrinkled, folded, indented or crenated. No lateral processes as in *Anelassorhynchus branchiorhynchus* Annandale & Kemp.

Setae: Two (with smaller reserve setae), length (measured in straight line from base to tip) up to 7.2 mm, strongly hooked and sickle-shaped. Strong interbasal muscle.

Nephridia: Two post-setal pairs; in one specimen three nephridia on one side and two on other. Length variable, some extending almost to posterior extremity of trunk. Nephrostomal lips long and much coiled.

Alimentary Canal: Long, much coiled. Presiphonal section of midgut long. Precloacal caecum present.

Vascular System: Dorsal vessel expands into a thin walled saccular vessel or heart. Well-developed ring vessel at junction of fore- and midgut gives off two neurointestinal vessels which join before they reach the interbasal muscle and then bifurcate to form a loop around the muscle. Ventral vessel pressed close to nerve cord and terminates in the cloacal caecum.

Anal Vesicles: Long, thin walled, brown, swollen basally in most specimens, bearing numerous, small, ciliated cups some on very short stalks. Anteriorly placed cups more sparsely distributed.

Systematics

These Australian specimens closely resemble *Ochetostoma septemyotum* Datta Gupta, Menon & Johnson, 1963 from Quillon, India. In none of the Australian specimens, however, has the oblique musculature of the body wall been found to form fascicles, like that shown for *Ochetostoma octomyotum* by Fisher 1946, pl. 23, fig. 2, and pl. 24 (in the spaces between muscles labelled MVL, ML and MDL) or like that shown in the transverse sections of *Ochetostoma bombayense* by Mathew 1976, fig. 5.

Because fasciculation of the oblique musculature is a character of *Ochetostoma*, the Australian specimens are considered different from *O. septemyotum*.

Edmonds (1963) originally described the specimens from Queensland as *Listriolobus bulbocaudatus*. At the time he was unaware of *L. brevirostris* Chen & Yeh Chen-Chang (1958) from Kiao-chow Bay, Shantung, China. At a later date Stephen and Edmonds (1972, p. 424) considered the two species were distinguished by three or four rows of prominent papillae and a bulbous structure both present at the posterior region of *L. bulbocaudatus*. More recently the author has examined three specimens from Queensland, in which the rings of prominent papillae and the bulbous structure are much reduced. This information brings the specimens within the range of *L. brevirostris*. Consequently *L. bulbocaudatus* is now considered to be a junior synonym of *L. brevirostris* Chen & Yeh Chen-Chang (1958).

Specimens examined and localities

Queensland: Yeppoon, SAM E1434 (1); Mud I., Moreton Bay, SAM E1433 (1); Round Is, Hervey Bay, SAM E1436 (1); Bramble Bay, SAM E1460 (1); ?Bramble Bay, SAM E1435 (4). Dredged from mud.

Distribution

China at Shantung. Australia: Queensland.

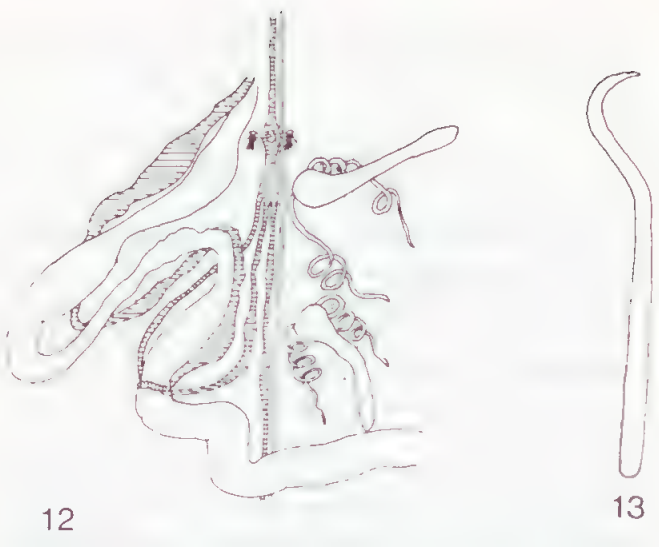
Genus **Ochetostoma** Leuckart & Rueppell

Ochetostoma Leuckart & Rueppell, 1828, pp. 7–8; Fisher 1946, p. 240; Stephen & Edmonds 1972, p. 426.

Type-species: *Ochetostoma erythrogrammon* Leuckart & Rueppell, 1828.

Diagnosis

Proboscis long, capable of much extension, non-bifid. Trunk medium to large with longitudinal musculature lying in well-defined bands. Intervals between bands crossed by numerous fascicles or small bundles of inner oblique musculature (Fisher 1946, pl. 23, fig. 2). Nephridia in one to seven pairs, with long spirally coiled nephrostomal lips. Setae two, with or without interbasal muscles. Anal vesicles long, more or less tubular, unbranched. Rectal caecum usually present.



FIGURES 12–13. *Listriolobus brevirostris*. 12, anterior region dissected; 13, seta.

KEY TO AUSTRALIAN SPECIES OF *OCHETOSTOMA*

1. *Longitudinal musculature in 11–13* (11–14) bands; three pairs of nephridia, one pair presetal, two pairs postsetal. Fasciculation of oblique musculature usually well developed. No interbasal muscle ..... *O. australiense*

   Longitudinal musculature in 17–19 (17–21) bands; two pairs of postsetal nephridia. Fasciculation of oblique muscualture well developed. Strong interbasal muscle ..... *O. baroni*

Ochetostoma australiense Edmonds (Figs 14–15, 23)

Ochetostoma australiense Edmonds, 1960, pp. 93–94, fig. 4, pl. 2b; Datta Gupta & Menon 1971, pp. 177–178, figs. 2c, 2e.

Type-specimen: AMS; type locality, mud flats at Dunwich (Stradbroke I.), Qu.

Description

Trunk: Usually large, sausage-like, cigar shaped or elongate, pale to dark red, length 40–130 mm, maximum width 15–30. Thickness of body wall variable, sometimes very thin. Surface, especially in anterior and posterior regions, covered by numerous small, flat, fleshy to wartlike papillae. Usually 12–13 (11–14) well developed longitudinal muscles best counted in dissected specimens. In 20 dissected specimens the maximum number of bands was 14 in 3, 13 in 10, 12 in 6 and 11 in one. Two

bands, one on each side of the nerve cord, lie very close together and may appear to be one. Oblique musculature between longitudinal bands usually grouped into numerous fascicles, which may be weakly developed or even absent in parts of some animals.

Proboscis: In living animals is highly extensible (150–200 mm), pale and ribbon-like. In fixed specimens shorter, fleshy, up to 60 mm long, with lateral margins rolled inwards on ventral side. Usually adherent or non-deciduate. Anterior extremity may be flattened somewhat and lateral margins may be slightly wrinkled. No lateral processes.

Setae: Two, 2.5–3.1 mm long (measured in a straight line from tip to midpoint of base), golden, encased in sheath connected to body wall by a number of setal muscles. No interbasal muscle.

Nephridia: Three pairs, the first presetal, others postsetal. Length variable, sometimes over half length of trunk. Nephrostomal lips elongate and spirally coiled, although sometimes only weakly. In one specimen only five nephridia present.

Digestive System: Mouth at base of proboscis. Foregut short, midgut very long and much coiled. Presiphonal section of midgut long and traversed for part of its length by ciliate groove. Siphonal section of gut also long. Well developed caecum present. Gut contents largely mud and sand; no faecal pellets.

Vascular System: Consists of dorsal blood vessel (sometimes well expanded), ring vessel or sinus (may also be expanded), two long neurointestinal vessels and a ventral blood vessel. Two neurointestinal vessels fuse to form one short vessel which joins the ventral vessel at about the level of the setae. Posteriorly ventral vessel gives off a branch to caecum.

Anal Vesicles: Two, long, slender, thin walled, light to dark brown, opening into cloacal region of intestine. Posses small, unstalked ciliate funnels.

Systematics

Edmonds (1960) considered these specimens with 11–14 muscle bands to be different from *O. erythrogrammon* Leuckart & Rueppell which possess 14–18 muscles. *O. erythrogrammon* and *O. australiense*, however, are closely related. The neurointestinal vessel of all the Australian specimens examined in the present study is double for most of its length. Datta Gupta & Menon (1971) state that the corresponding vessel in their specimens of *O. erythrogrammon* is single. If this difference always exists, it further distinguishes the two closely allied species. Sato (1939, fig. 9), however, shows two neurointestinal vessels for his specimens of *O. erythrogrammon*.

Stephen & Edmonds (1972) list nine species of *Ochetostoma* that possess three pairs of nephridia and in which the number of longitudinal muscles varies from 12 to 22. Wesenberg-Lund (1939) and Sato (1939) considered that they were conspecific. If they are correct then *O. australiense* would become *O. erythrogrammon*.

Specimens examined and localities

Queensland: Dunwich (in mud flats in front of cemetary) SAM E1410 (4) and E1411 (1); Caloundra (dug at low tides from mud flat; opposite a small mangrove island) SAM E1415 (7); Myora (in mud flats at low tide) SAM E1413 (20).

New South Wales: Goodwood I. (near mouth of Clarence River) AMS W3186, W3375, W3817; Brunswick Heads (1) AMS coll.

Habitat

At Goodwood I., the worms are found 'between high and low water marks in rather dark sand situated close to some small mangrove clumps. The proboscis is white and fleshy and protrudes from a hole in the sand. It lies along the surface of the sand and is about 6" long and 1/2" wide. In this condition it appears to be quite flat (like a ribbon) and does not appear to take on a tube-like shape as in preserved specimens. The body of the worm is soft and bright red in colour. Twelve longitudinal muscles show up clearly' (P. Durie pers. comm.)

Distribution

Eastern Australia from Caloundra (Qu.) to Goodwood I. (N.S.W.). Andaman I. (Datta Gupta & Menon, 1971). An inhabitant of intertidal mud flats.

Ochetostoma baroni (Greeff)
(Fig. 24)

Thalassema baronii Greeff, 1879, pp. 141–152, pl. 6, figs 62–67.
Ochetostoma baronii Mackie, 1961, p. 247; Stephen & Edmonds 1972, p. 429; Amor 1976, p. 123–124.
Ochetostoma myersae Edmonds, 1963, pp. 245–246, pl. 1, fig. 2.

Previous Australian record: N.S.W. (Edmonds 1963).

Description

Trunk: Small to moderately large, sac-, sausage- or cigar-shaped, length 21–70 mm, maximum width 9–25 mm; anterior region rounded, posterior sometimes almost pointed. Green. Surface covered with soft, almost white, slightly elevated, wart-like papillae, largest in posterior region of trunk. Longitudinal musculature in 18–19 (21 in one specimen) bundles. Oblique musculature between

longitudinal muscles forms fascicles which sometimes are only weak.

Proboscis: In preserved specimens about half to fifth length of trunk, either deciduate or non-deciduate. Lateral margins tend to roll inwards so as to form a tube. Plump and almost concial in largest specimen.

Setae: Two, up to 3.1 mm long, golden, connected by strong interbasal muscle.

Alimentary Canal: Mouth at base of proboscis. Gut much coiled and filled with coral and shell fragments; obviously animal is able to ingest larger particles than *Ochetostoma erythrogrammon* and *Bonellia viridis* (Chuang 1962, Jaccarini & Schembri 1977).

Nephridia: Two post-setal pairs, nephrostomal lips long, weakly or strongle coiled. Largest ova 0.09–0.11 mm in diameter.

Anal Vesicles: Two, very large, slender, tapering distally and bearing numerous, small, brown unbranched ciliate cups or funnels.

Vascular System: Dorsal blood vessel, ring vessel, two neuro-intestinal vessels and ventral vessel. Neurointestinal vessels long but fusing to form one short vessel which joins ventral vessel at about level of setae.

Systematics

Ochetostoma myersae Edmonds, 1963, was described from N.S.W. as possessing 18–21 longitudinal muscles, two pairs of post-setal nephridia and unbranching ciliate funnels. At the time the species was considered to be different from *O. baronii* (Greeff) in which the ciliate funnels were described as being branched, a fact confirmed by Fischer (1895: 19).

Amor (1976, p. 123), however, after studying specimens collected at Canary Is (type locality), Brazil and Galapagos Is. found that 'amongst the 38 specimens examined there did not exist any branched outgrowths in the anal vesicles'. The examination of three specimens of *O. baroni* from Arrecife, Canary Is, collected by A.K. Totten and identified by A.C. Stephen (B.M. 11.7.7.37). confirms Amor's finding that the funnels are unbranched.

In view of this evidence (especially as Amor examined 38 specimens) the statements of Greeff and Fischer about the branching of the ciliate funnels are questionable. Consequently the chief reason given by Edmonds (1963) for separating *O. myersae* and *O. baronii* is now invalid and *O. myersae* becomes a junior synonym of *O. baronii*. Amor (1976: 123) also considers *O. edax* Fisher, 1946 and *O. kefersteini* (ten Broeke, 1925) as junior synonyms of *O. baronii*.

O. punicea (Dartnall, 1976) is very closely related to *O. baronii* if the ciliated funnels of the latter are unbranched. *O. punicea* has 18–19 longitudinal muscles, fasciculated oblique musculature, setae about 2.25 mm long, two pairs of post-setal nephridia with spirally coiled lips and anal vesicles with unbranched ciliate cups. No interbasal muscle, however, is present and the left anal vesicle is not symmetrically placed in relation to the right. Whether the last character is taxonomically significant is doubtful. The species was described from Great Tulear Reef, off south-west Madagascar.

Specimens examined and localities

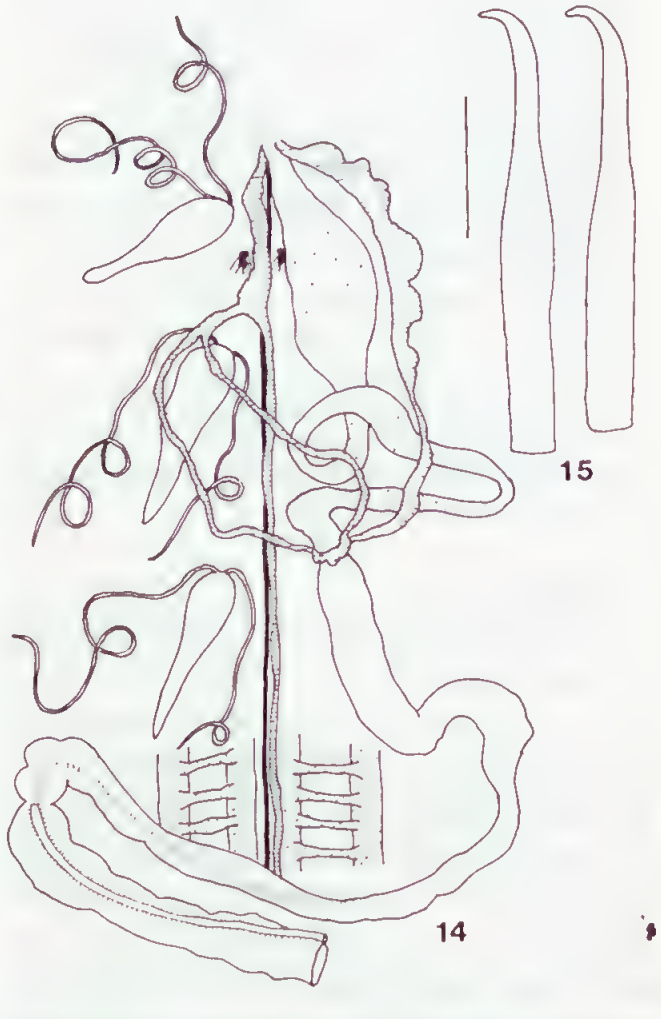
New South Wales: Long Reef (near Sydney) (1) AMS 3357; Collaroy, AMS W3368 (1); Minnie Waters, 'intertidal region of low tide' AMS coll. (1).

Queensland: Bird I. (Moreton Bay) (1) SAM E1417.

Distribution

Eastern Australian from Sydney (N.S.W.) to Moreton Bay (Qu.).

Extra Australian, wide: Atlantic Ocean (Canary I., Bermuda, West Indies, Senegal, Florida, Brazil); Indian Ocean (Zanzibar, Amboina); Pacific Ocean (Papua, Loyalty I., Galapagos).



FIGURES 14–15. *Ochetostoma australiense*. 14, anterior region dissected; 15, setae (scale line = 1.0 mm).

Genus **Thalassema** Lamarck

Thalassema Lamarck, 1801, p. 28; Fisher 1946, p. 230; Stephen & Edmonds 1972, p. 452.

Type-species: *Lumbricus thalassemus* Pallas, 1776 = *Thalassema thalassemum* (Fisher, 1946).

Diagnosis

Echiuridae with well developed, long, non-bifid but usually truncated proboscis Two ventral setae; lacking anal setae. Longitudinal, circular and oblique musculature continuous. Nephridia in one or two pairs; nephrostome basal and nephrostomal lips neither elongated nor spirally coiled.

Thalassema sydniense Edmonds (Figs. 16–17)

Thalassema sydniense Edmonds, 1960, p. 89–90, figs. 1–2, pl. 1a.

Holotype: AMS G11219; off Watson Bay, Sydney, N.S.W.

Description (based on four specimens reported in Edmonds, 1960 and two additional ones)

Trunk: Small, grey-brown, sausage to sub-ovoidal; length 2.5–8 mm (most about 5), width 1–2.7. Surface covered with papillae, lying almost in rows and largest posteriorly. Musculature continuous.

Proboscis: Firmly attached, as long as trunk or less, becoming narrower anteriorly.

Setae: Two, golden brown, 1.0–1.1 mm long, with strongly recurved tip; strong interbasal muscle and well developed system of setal muscles.

Nephridia: Two pairs, post-setal. Nephrostome on short stalk near proximal extremity of nephridium; lips expanded but not elongate or spirally coiled. One specimen with only 3 nephridia.

Alimentary Canal: Very long, intestinal siphon present but no caecum.

Anal Vesicles: Two, expanded towards base; surface with ciliated cups.

Systematics

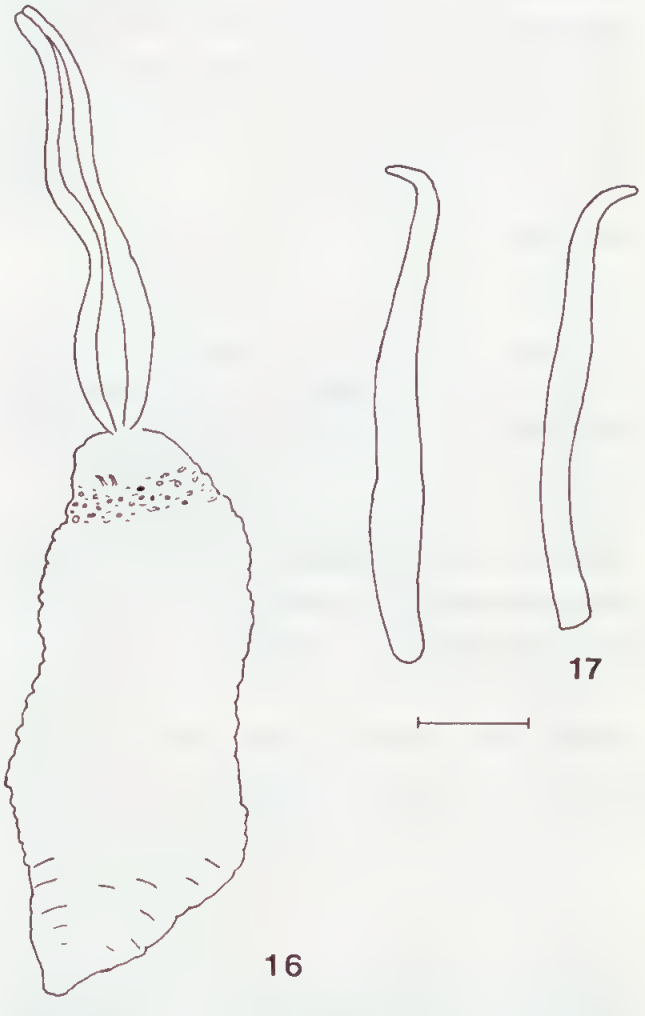
These specimens resemble *Thalassema steinbecki* Fisher, 1946, which occurs along the Pacific coast of North America from California to Ecuador and which has also been reported from the Indian Ocean (Datta Gupta 1975). *T. sydniense* differs from *T. steinbecki* because its nephrostomes are on short stalks or peduncles. *T. sydniense* is known only from six specimens, four of which are very small. It is not a well known species and needs redescription when more specimens become available. Whether the species is a small one or whether the specimens so far collected are simply small ones is not known.

Specimens examined and localities

New South Wales: Watson Bay, AMS G11219 (4).

Victoria: 40° 39'0"S, 144° 56'E (Bass St Survey) MV G3386 (2).

No other records.



FIGURES 16–17. *Thalassema sydniense*. 16, entire animal (scale line = 1.00 mm); 17, seta (scale line = 0.25 mm).

Genus **Ikeda** Wharton

Ikeda Wharton, 1913, pp. 260–261; Fisher 1946, pp. 220; Stephen & Edmonds 1972, pp. 471–472.

Type-species: *Thalassema taenioides* Ikeda, 1904.

Diagnosis

Trunk very long with longitudinal musculature thickened to form bands. Proboscis very long, non bifid. Nephridia very numerous and unpaired.

Ikeda sp.

The very long proboscis of an echiuran has been noticed and collected a number of times by divers

in St Vincent Gulf, S.A. [Edmonds 1982, pl. 23 (4)]. They report that the organ is able to extend for more than 1.5 m. The echiuran itself, however, has proved very difficult to collect on account of the depth of its burrow and the problem of digging in sand at depths of 6–10 m. So far only one specimen has been collected. Unfortunately, it was considerably damaged so that only a limited amount of information can be given about it. Several intact probosces of other specimens have been collected.

The worm resembles in some respects *Ikeda taenioides* (Ikeda, 1904), known from six Japanese specimens. A specific identification of the specimen from S.A. is not possible on account of the damage to its nephridial and anal regions. I am, however, tentatively assigning it to the genus *Ikeda*.

Description

Trunk: Long, slender, worm-like, rather flat in preserved condition; 290 mm long, 7–11 mm wide, pinkish-brown when collected but dark brown when fixed. Longitudinal musculature grouped in 5 bands prominent externally; numerous small sub-globular papillae cover surface of much of trunk.

Proboscis: Flat, about 400m long, 5–10 wide, with margins in fixed specimens slightly frilled; one surface cream-brown in colour marked with almost transverse brown-black stripes; posterior region of proboscis (near mouth) modified to form cup-like structure.

Setae: Two, about 10 mm long, with well developed setal muscles. Nephridial region much damaged.

Anal Vesicles: Missing.

Alimentary Canal: Very long and convoluted. Some eggs with maximum diamter 0.35–0.38 mm entangled in gut.

Specimens examined and localities

'Kemps Ground', off Glenelg, St Vincent Gulf, S.A., at 9–10 m, 13 March, 1986, one spec. coll. N. Holmes and S. Parker; SAM E1509; separate probosces of other specimens SAM E1587. Coffin Bay (near Black Springs), Eyre Peninsula, S.A. (proboscis only).

Acknowledgments

Thanks are due to the following for help with specimens: from W.A., Mrs L. Marsh, Mrs S. Slack-Smith, Dr E. Hodgkin and Dr B. Wilson; from S.A., I.M. Thomas, Mrs K. Gowlett-Holmes, N. Holmes, Miss H. Kald and W. Zeidler; from Vic., Dr B. Smith and Mrs H. Black; from Tas., Dr A. Dartnell and Dr A. Green; from N.S.W., Dr P. Hutchings, Miss P. Wearne, Miss E. Pope and Miss E. Bennett; from Qu., Prof W. Stephenson, W. Green, S. Cook, O. Kelly and Mrs M. Specht. Mr P. Kempster (University of Adelaide) took the photographs and Dr I. Beveridge (Institute of Medical and Veterinary Sciience, Adelaide) made sections of the body wall of one species. Mr R. Sims and Mr E. Easton (British Musuem of Natural History, London) and Dr M. E. Rice (Smithsonian Institute, Washington D.C.) kindly sent specimens on loan. Dr E. Matthews (SAM) helped with translations from Russian.

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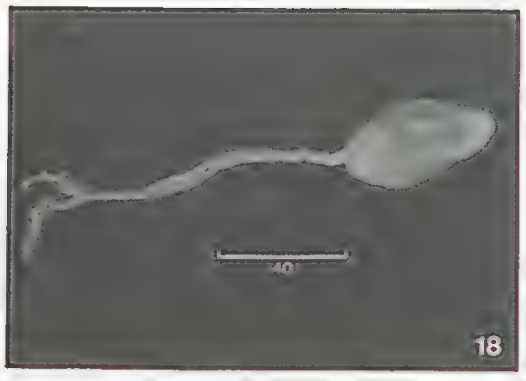

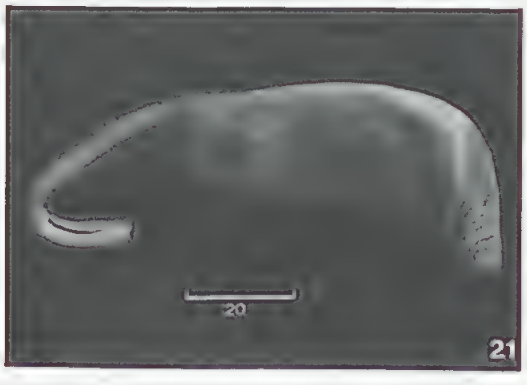

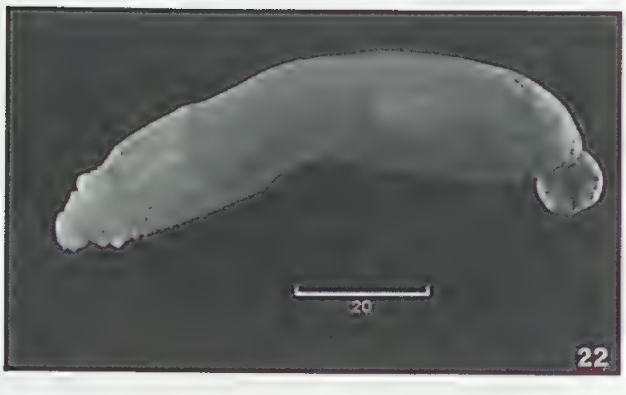

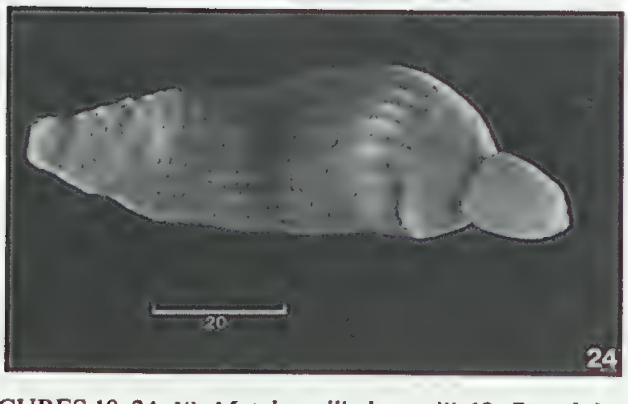

FIGURES 18–24. 18, *Metabonellia haswelli*; 19, *Pseudobonellia biuterina*; 20, *Anelassorhynchus porcellus porcellus*; 21, *Anelassorhynchus porcellus adelaidensis*; 22, *Listriolobus brevirostris*; 23, *Ochetostoma australiense*; 24, *Ochetostoma baroni*.

FURTHER OBSERVATIONS ON PENTASTOMIDS (ARTHROPODA) PARASITIC IN AUSTRALIAN REPTILES AND MAMMALS

J. RILEY & D. M. SPRATT

RILEY, J. & SPRATT, D. M. 1987. Further observations on Pentastomids (Arthropoda) parasitic in Australian reptiles and mammals. *Rec. S. Aust. Mus.* 21(2): 139–147.

A collection of adult and nymphal pentastomids representative of at least four genera is described. Two species of *Raillietiella* and one species of *Parasambonia* from snakes (*Pseudechis australis, Pseudonaja textilis* and *Cryptophis nigrescens*) are probably new, but more specimens are required before their status can be confirmed. Mature and immature *Waddycephalus longicauda, W. superbus* and *W. punctulatus* (all Riley & Self 1981) are identified from snake hosts but specific determination of five lots of specimens was not possible. Evidence endorses an earlier suggestion that there may be two species of *Waddycephalus* in tiger snakes; *W. scutata* from island populations and an unnamed species from mainland populations of the *Notechis scutatus/ater* complex. Nymphal specimens of *Waddycephalus* from marsupials (*Parantechinus apicalis* and *Dasykaluta rosamondae*), a snake (*Cryptophis nigrescens*), a gecko (*Heteronotia binoei*), a skink (*Hemiergis decresiensis*) and frogs (*Ranidella remota* and *Palmatorappia solomonis*) all bear characteristic double hooks. The accessory spine above the hook arises from a point midway between the hook and the fulcrum and appears to be an integral and functional part of the hook. *Armillifer australis* Riley & Self, 1981 is described from infections in four pythons (*Morelia amethistina* and *Morelia spilota*); the latter is a new host record. A single nymph recorded from the body cavity of *Rattus leucopus* is identified as *A. australis* on the basis of abdominal annulus counts.

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In an historical review of Australian Pentastomida, Riley, Spratt & Presidente (1985) recorded seven genera comprising 17 species occurring in Australian reptiles and mammals, and identified nymphal *Waddycephalus* spp. and *Armillifer* spp. from marsupials. This paper reports primarily on a pentastomid collection in the South Australian Museum (SAM) and describes further adult and nymphal material, attributed to the genera *Waddycephalus* and *Armillifer*, from reptiles, amphibians and mammals. The double nature of the hook of nymphal *Waddycephalus* (Riley *et al.* 1985) is confirmed, as are earlier observations (Riley & Self 1981b) of significant anatomical differences between mainland and island forms of *Waddycephalus* infecting the same species of snake. Two large raillietiellids and two parasambonids from snakes are described, however more material is required before their specific status can be confirmed as new.

Materials and Methods

The material examined in this study was collected primarily in eastern mainland Australia, Tasmania and neighbouring offshore islands. It is supplemented by nymphal *Waddycephalus* (or *Elenia*?) spp. from the Solomon Islands and New Guinea.

The methods are those outlined in Riley *et al.* (1985) and the hooks of raillietiellids were measured according to the convention of Ali *et al.* (1982) i.e. barb length AB (notation AD in error, p. 42, Riley *et al.* 1985), shank length BC. Overall hook length of the double hooks of nymphal *Waddycephalus* spp. was measured according to the convention illustrated in Figure 2. All measurements are in micrometers with the exception of body length, which is in millimetres. Most specimens are deposited in the South Australia Museum (SAM), Adelaide; two lots are deposited in the Queensland Museum (QM), Brisbane. Reptile nomenclature follows Cogger, Cameron & Cogger 1983; dasyurid marsupial nomenclature follows Archer 1982.

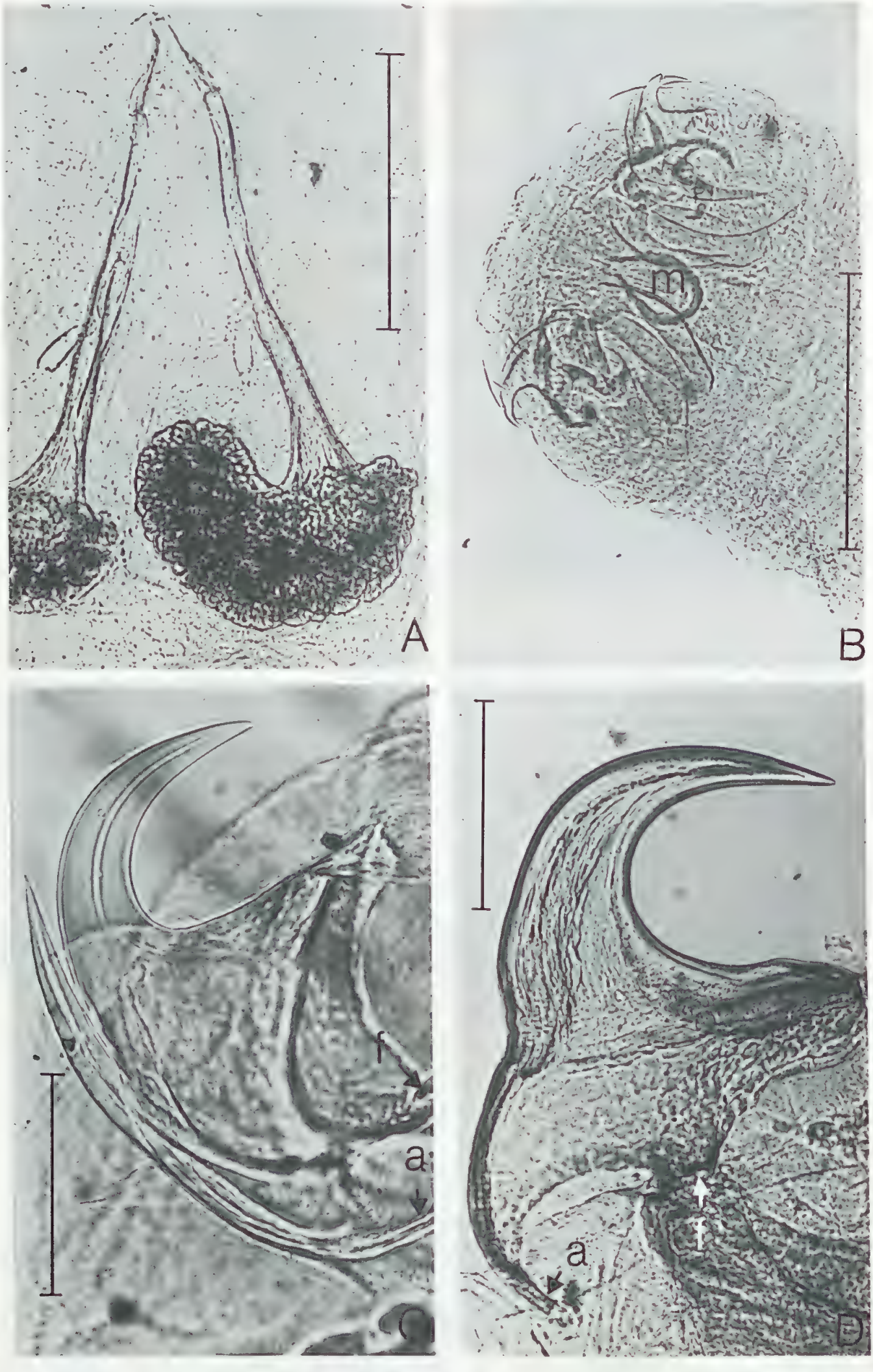
Order **CEPHALOBAENIDA**

Raillietiella spp. from snakes

Raillietiella sp. ***a***

Material Examined

From lung of *Pseudechis australis* (Gray), locality unknown (died in Melbourne Zoo), in SAM No. N1980183.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Description

Female (n = 4). Length 33–52 ($\bar{x}$ = 42), with 45 or 6, 41 or 2, 36 (?) and 39 (?) annuli respectively. Posterior hook of 52 mm specimen, AB 240, BC 370.

Male (n = 1). Length approx. 9, annuli uncountable and therefore slide-mounted. Posterior hook, AB 135; BC 220. Base of copulatory spicule massive, maximum diameter 520 and covered with a reticulum of tubular elevations (Fig. 1A).

Discussion

The heavily ornamented male spicule, 520 μm across at the base (Fig. 1A), is virtually identical to those of *R. orientalis* and *R. agcoi* (Ali, Riley & Self 1982). *R. orientalis* infects colubrid, viperid and elapid snakes in south-east Asia and Taiwan whereas *R. agcoi* is found only in cobras in the Philippines. The females of these two species are distinguished in a number of ways: the former has bigger hooks (see Fig. 3, in Ali *et al.* 1982), more annuli (33–47 *contra* 30–35) and is generally longer and stouter than *R. agcoi*. The overall shape of the present species, and its hooks, are reminiscent of *R. agcoi* but its annulus count, though variable, is within the range of *R. orientalis*. The host, the king brown snake, *Pseudechis australis*, is an endemic species and its raillietiellid parasite may be unique by virtue of geographic isolation. This is probably a new species, but, because it combines important characteristics of these two closely related species we have left it unnamed, pending more specimens and more refined diagnostic techniques.

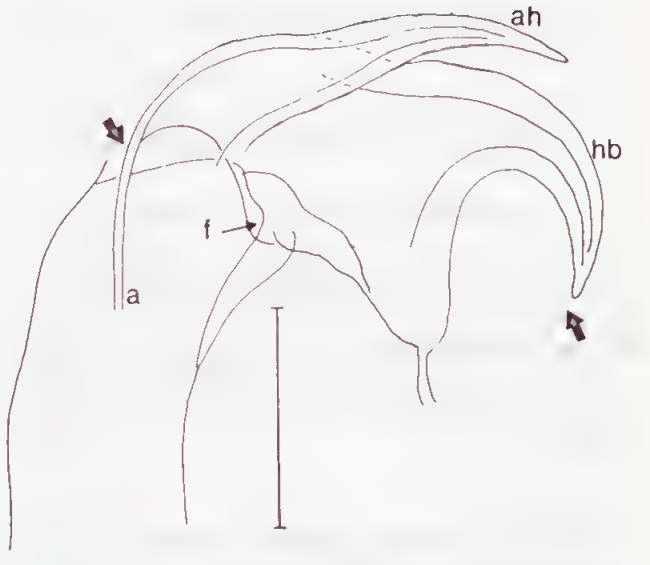

FIGURE 2. Diagrammatic representation of hook of nymphal *Waddycephalus* sp. The distance between the larger arrows indicates our measurement of the overall length (a = apodeme; ah = accessory hook; f = fulcrum; hb = hook barb) (scale bar = 120 μm).

Raillietiella sp. *b*

Material Examined

From lung of *Pseudonaja textilis* (Duméril, Bibron & Duméril), Townsville, Queensland, in SAM No. N1985149.

Description

Female (n = 2). One headless abdomen; length other specimen 50, annuli uncountable, specimen therefore slide-mounted. At least 30–40% of eggs in uterus contain fully-developed primary larvae; the specimen is therefore mature. One posterior hook measured, AB 400; BC 510.

Discussion

Apart from the species recorded above, only two raillietiellids are known from Australia; *R. amphiboluri* from the bearded dragon, *Amphibolurus barbatus* (Cuvier), (Mahon 1954, Riley *et al.* 1985) and *R. scincoides* from the eastern blue-tongued lizard, *Tiliqua scincoides* (White), (Ali, Riley & Self 1984): the latter has blunt-tipped posterior hooks and *R. amphiboluri* is smaller than the present species with much smaller hooks (AB 200–220; BC 370) (Ali *et al.* 1985) (notation AD in error).

The intact specimen clearly belongs to the Group VI taxon of raillietiellids (Ali *et al.* 1985) which includes all of the species from snakes. The two species, *R. orientalis* from south-east Asia and Indonesia and *R. agcoi* from the Philippines are, zoogeographically, most proximate to the present specimen, but it has much longer hook barbs (dimension AB) than either of these species (compare with Fig. 3 in Ali, Riley & Self 1982). This is almost certainly a new species but the poor state

FIGURE 1. A. Copulatory spicules of male *Raillietiella* sp. from *Pseudechis australis* showing massive base covered with tubular elevations (scale bar = 500 μm). B. Cephalothorax of male nymph of *Waddycephalus* sp. from mesentry of *Satanellus hallucatus* [described by Riley *et al.* (1985)]. The double nature of the outer hooks is obvious but the inner hooks are not in the plane of focus (m = mouth) (scale bar = 500 μm). C. Outer hook of nymph of *Waddycephalus* sp. from *Hemiergis decresiensis* showing spinous extension. The back of the extension forms a long apodeme (a) (f = fulcrum) (scale bar = 100 μm). D. Hook of adult *Armillifer* sp. from python (S.A.) illustrating typical unornamented porocephalid hook (a = apodeme; f = fulcrum) (scale bar = 200 μm).

of preservation and lack of males precludes specific identification.

Order **POROCEPHALIDA**

Parasambonia spp. from snakes

Parasambonia bridgesi Riley & Self

Material Examined

From lung of *Pseudechis porphyriacus* (Shaw), Healesville Sanctuary, Victoria, in SAM No. N1980173.

Description

Female (n = 2). Length 26, with 50 and 54 pre-vaginal and post-vaginal annuli.

Male (n = 1). Length 7, with 53 annuli.

Discussion

There are no uncertainties regarding the status of these specimens. All of the characters fall well within the ranges described for *P. bridgesi* by Riley & Self (1982).

Parasambonia* sp. *a

Material Examined

From lung of *Austrelaps superbus* (Günther), 5 km south of Bowral, New South Wales, in SAM No. N1986192.

Description

Male (n = 1 plus 2 anterior ends). Length 8, with 51 annuli. Heads slide-mounted, outer hook with finger-like extension, AD 175, 190; BC 95, 100.

Discussion

The outer hooks possess the projecting spine characteristic of the genus *Parasambonia*. The low annulus count is more characteristic of *P. minor* than *P. bridgesi*, however the hook dimensions are much smaller than those of *P. minor*, the dimensions of which do not overlap with the much larger hooks of *P. bridgesi* (Riley & Self 1982). The absence of fully gravid females precludes confident specific identification. *P. minor*, but not *P. bridgesi*, has been recorded from the copperhead (Riley & Self 1982).

Parasambonia* sp. *b

Material Examined

From lung of *Cryptophis nigrescens* (Günther), Mogo S.F., New South Wales, in SAM No. N1986191.

Description

Female (n =1). Length 29, annuli uncountable. Outer hook with projecting spine, AD 465; BC 245.

Discussion

Hook dimensions in this gravid specimen are larger than those reported in species of *Parasambonia* from Australian snakes (Riley & Self 1982), suggesting that it represents a new species. Additional specimens in good condition are required to resolve this matter. The stomach of this small-eyed snake contained a partly-digested eastern water skink, *Sphenomorphus quoyii* (Duméril & Bibron).

Waddycephalus spp. from snakes

Waddycephalus longicauda Riley & Self

Material Examined

From lung of *Demansia psammophis* (Schlegel), Queensland National Parks and Wildlife Service, Moggill, Queensland, in QM No. W12193.

Description

Female (n = 1). Length 27, with 49 pre-vaginal and 7 post-vaginal annuli, preadult.

Male (n = 6). Length 8–11, with 56–59 annuli ($\bar{x}$ = 57).

Discussion

The features of this material, particularly the long and finely tapered post-vaginal tail, are characteristic of *W. longicauda* (Riley & Self 1981b).

Waddycephalus* sp. *a

Material Examined

From lung of *Pseudonaja textilis* (Duméril, Bibron & Duméril) taken at Halls Gap, Grampians, Victoria, in SAM No. N1980204.

Description

Female (n = 1). Length 37, with 63 pre-vaginal and 4 post-vaginal annuli. Hooks removed from one side, BC 530, 540; AD 860, 890.

Discussion

The only pentastomid described from *P. textilis* is a female which was tentatively identified as *W. porphyriacus* purely on the basis of similarities in annulus counts: hooks were not measured (Riley & Self 1981b). The present fully mature specimen has far fewer pre-vaginal annuli (63 *contra* 75) than the type series of *W. porphyriacus*. Hook dimensions are very much smaller than those of *W. porphyriacus* and similar to *W. superbus* from a

copperhead, *Austrelaps superbus* (Günther), and to an unnamed species from a mainland tiger snake, *Notechis scutatus* (Peters) (Riley & Self 1981b). Two other characters, the number of annuli and the attenuated caudal extremity, also place it close to these species. However, the type series of *W. superbus* was derived from copperheads taken in Tasmania and nearby islands (Riley & Self 1981b), as was a more recently described infection (Riley *et al.* 1985). To date, *W. superbus* is recognised only as an island species, although copperheads are known on the mainland where their range overlaps that of *P. textilis*. Different dietary preferences have been reported in these snakes (Cogger 1983) however, the food habits of different populations of a snake species over its geographic range are not well known. Recent evidence suggests strongly that dietary preference is different in regions where food resources are skewed or limiting (Schwaner 1985). Until more specimens become available the status of the *Waddycephalus* from *Pseudonaja textilis* remains uncertain.

Waddycephalus sp. *b*

Material Examined

From lung of *Notechis ater niger* Kinghorn, Reevesby I., South Australia, in SAM No. N1985151.

Description

Female (n = 2). Both specimens in very poor condition, length about 36–38, no detail of annulation could be discerned. Hooks from one specimen, BC 400, 410; AD 705, 690.

Discussion

The hooks are much smaller than those of all recognised species of *Waddycephalus* except *W. scutata*, also taken from a tiger snake, on St Francis Island, South Australia. Riley & Self (1981b) recorded the host of the type as *Notechis scutata* (= *scutatus*), based on the collector's label in the vial. Cogger (1983) recognised *N. scutatus* as a purely mainland species being replaced by *N. ater* on islands off the coast of South Australia. However, recent studies of morphological variation in tiger snakes on Kangaroo Island have revealed banded, unbanded, red-bellied and melanistic forms believed to belong to the same species complex (Schwaner 1984). Thus *W. scutata* is currently recognised as a parasite only of island populations of the *N. scutatus/ater* complex, its principal distinguishing characteristic being its particularly small hooks. Hook dimensions in the present specimens form a cluster distinct from *W. scutata* (compare with Fig. 6 in Riley & Self 1981b and below) and suggestive of a new species of *Waddycephalus*.

Waddycephalus sp. *c*

Material Examined

From lung of *Notechis scutatus* (Peters), Grampians, Victoria, in SAM No. N1980171.

Description

Female (n = 7). Length 32–43 ($\bar{x}$ = 38), with 60–63 pre-vaginal (x = 61.5) and 2–5 ($\bar{x}$ = 3.2) post-vaginal annuli. Hooks taken from one side of 32 mm and 40 mm females, BC 495, 535; AD 885, 910 respectively.

Male (n = 4). Length 14–20 ($\bar{x}$ = 16), 62–68 annuli ($\bar{x}$ = 64).

Discussion

In their review of the genus *Waddycephalus* Riley & Self (1981b) separated the species from tiger snakes (*Notechis* spp.) into two groups distinguished principally by marked differences in hook size: small hooks are characteristic of *W. scutata* from island populations of the *Notechis scutatus/ater* complex whereas larger hooks are found in specimens from mainland tiger snakes (see Fig. 6 in Riley & Self 1981b). They concluded that geographical isolation was responsible for the observed differences and that two hosts may be involved. The present findings substantiate these differences and combine to suggest indeed that there may be two species of *Waddycephalus* infecting tiger snakes. More sophisticated diagnostic techniques, preferably utilizing live material, are required to confirm this postulate.

Waddycephalus superbus Riley & Self

Material Examined

From lung of *Austrelaps superbus* (Günther), (a) Launceston, (b) Longford, Tasmania, in SAM Nos. (a) N1980175, (b) N1980205.

Description

Female (a) (n = 3). Length 37–41, with 59–63 pre-vaginal and 3–4 post-vaginal annuli. Hooks from one side of 40 mm specimen, BC 530, 580; AD 900, 970.

Female (b) (n = 2). Most of abdomens missing, annuli uncountable; both apparently mature. Hooks dissected from one side of both females, BC 525, 525; AD 840, 840 respectively.

Male (b) (n = 1). Length 15, possibly 62 annuli.

Discussion

These specimens are very similar to the type series of *W. superbus* (from the same host species also taken in Tasmania) except that one specimen from Launceston has two more abdominal annuli and the hooks are slightly larger than those described by

Riley & Self (1981b) and Riley *et al.* (1985). Nevertheless, all of the hook dimensions measured to date combine to form a discrete cluster group and this species at least, is now well characterized. All specimens recovered thus far come from Tasmania, endorsing the suggestion that *Waddycephalus teretiusculus* Baird, 1862, the type species of the taxon and also occurring in the copperhead, is probably a mainland species (Riley & Self 1981b, Riley *et al.* 1985). Lungs of specimens of *A. superbus* held in the Australian National Wildlife Collection were examined for *W. teretiusculus* from the following mainland localities (numbers of specimens in parentheses) but pentastomids were not recovered: Mt Gingera, ACT (1); Ginini Flats, ACT (1); Captain's Flat, NSW (3); Pepper Creek on Big Badja Mountain via Numeralla, NSW (1); Kosciusko National Park near Kiandra entrance (1) and near Peak River, NSW (1); Tumbarumba, NSW (1); Portland, Vic. (2); Flinders I. (1).

Waddycephalus sp. ***d***

Material Examined

From lung of *Drysdalia coronoides* (Günther), Fenelon I., South Australia, in SAM No. N1985152.

Description

Female (n = 1). Immature, slide-mounted. Length 10, with 56 pre-vaginal and 5 post-vaginal annuli. Hook measurements BC 280, 300; AD 430, 420.

Male (n = 1). Immature, slide-mounted. Length 9, with 64 annuli.

Discussion

The host snake was originally recorded as *Denisonia coronoides* but species of *Drysdalia* were formerly included in the genus *Denisonia*. The immature state of the present specimens precludes specific identification.

Waddycephalus punctulatus Riley & Self

Material Examined

From lung of *Dendrelaphis punctulata* (Gray), Northern Territory, in SAM No. N1985153.

Description

Female (n = 1). Length 33, with 52 pre-vaginal and 11 post-vaginal annuli.

Male (n = 1). Length 14, possibly 61 annuli.

Discussion

There is no confusion concerning the status of these specimens from the common tree snake; their size and annulus number agree well with the original description of *W. punctulatus* (Riley & Self 1981b).

Waddycephalus sp. ***e***

Material Examined

From lung of *Morelia spilota* (Lacépède), St Francis I., South Australia, in SAM No. N1985154.

Description

Female (n = 1). Immature, length 9.5, with 52 pre-vaginal and 4 or 5 post-vaginal annuli.

Discussion

The anterior part of the cephalothorax, including the pair of inner hooks and the mouth are missing. The outer hooks lack the projecting spine characteristic of *Parasambonia* spp. (Riley & Self 1982). The position of the vagina places the specimen in the family Sambonidae and the annulus count indicates that it is a species of *Waddycephalus* but, it has far fewer annuli than the immature female described previously from the same host species and tentatively identified as *W. porphyriacus* (Riley & Self 1981b).

Nymphal **Waddycephalus** spp.

Material Examined

(i) from *Parantechinus apicalis* (Gray), locality unknown, in SAM No. N1980210.

(ii) Encysted in a skink, *Hemiergis decresiensis* (Cuvier), South Australia, in SAM No. 1985155.

(iii) Encysted in abdomen of *Dasykaluta rosamondae* Ride (a) Woodstock Station, (b) Abydos Station, near Marble Bar, Western Australia, in SAM Nos. (a) N1985156, (b) N1980182.

(iv) One nymph, from below post-orbital skin of a frog, *Ranidella remota* Tyler & Parker, Papua New Guinea, in SAM No. N1985157.

(v) 14 nymphs encysted in intestinal connective tissue of *Cryptophis nigrescens* (Günther), Mogo S.F., New South Wales, in SAM No. N1986190.

(vi) 3 nymphs encysted in gecko, *Heteronotia binoei* (Gray), Girraween National Park, Wyberba, Queensland, in QM No. W12194.

Description

(i) Three nymphs dissected from cysts and slide-mounted. Length about 6, 1 specimen (sex unknown) with 74 annuli, 1 male with 70 annuli. All hooks double, overlain by accessory spine (Fig. 2) the base of which arises from a point between fulcrum and hook. Spine an integral part of hook and attached to fulcrum only by thin, flexible sheet of cuticle. Overall hook length (measurement as illustrated in Fig. 2) 300–340.

(ii) Three nymphs dissected from cysts and slide mounted. Length about 4–5, with 62–63 annuli, sex indeterminable. Hooks double, overall length 210–250 (Fig. 1C).

(iiia) All dissected from cysts and slide-mounted. Length about 6, with 56–62 annuli ($\bar{x}$ = 60). Hooks double, overall length 250–280.

(iiib) Six small cysts opened and nymphs slide-mounted, large composite cyst containing many larvae left intact. Length 4–5, with 56–59 annuli (3 counted). Hooks double, overall length 230–260.

(iv) Male nymph, length approximately 4, with 56 annuli. Hooks double, not dissected and measured.

(v) Three nymphs slide-mounted. Length about 5, with 56–58 annuli ($\bar{x}$ = 57). Hooks double, overall length 170–180.

(vi) Length about 5, with 56–61 annuli ($\bar{x}$ = 58). Hooks double, overall length 195–215.

Discussion

Riley *et al.* (1985) ascribed a double-hooked male nymph from the northern quoll, *Satanellus hallucatus* (Gould), to the genus *Waddycephalus* exclusively on the number of annuli, which vary from 55–78 in adult males of the genus (Riley & Self 1981b). This is considerably more than occurs in the two other genera which may have double-hooked larvae, *Elenia* and *Parasambonia* (Heymons 1939, Riley & Self 1982, Riley *et al.* 1985). All of the present specimens are placed in the genus *Waddycephalus* for the same reason, although specific identification is not possible.

The specimens from *D. rosamondae* probably belong to the same species, those from Abydos Station being at a slightly earlier stage of development.

The nymph from *R. remota* may be *W. punctulatus*. This species was first described from the common tree snake *Dendrelaphis punctulata* (Gray) in Australia (Riley & Self 1981b) but this host also occurs in New Guinea (Cogger 1983). The prey of tree snakes consist of frogs and birds, although reptiles and small mammals are occasionally eaten (Cogger 1983). Clearly frogs are probable intermediate hosts of *W. punctulatus*.

Either **Waddycephalus** or **Elenia** sp.

Material Examined

One nymph, from submandibular lymphatic sac of a frog, *Palmatorappia solomonis* (Sternfeld) Solomon Islands, in SAM No. N1985158.

Description

Male. Length 5, with 48 annuli. Hooks double, overall length 220–230.

Discussion

The generic status of this nymph is uncertain. *Waddycephalus komodoensis* and *W. radiata* are known from Indonesia (Riley & Self 1981b) and *Elenia vitiensis* is known from the Islands of Fiji (Heymons 1932). The low annulus count of the specimen may just preclude it being a species of *Waddycephalus*; the lowest annulus number known in mature males is 52, occurring in *W. komodoensis* (Riley & Self 1981b).

Armillifer sp. from snakes and rodents

Armillifer australis Riley & Self

Material Examined

(i) From viscera (the specimens probably inhabited the membranous lung which is often mistaken for the abdominal cavity) of a python (species unknown), South Australia, in SAM No. N1980207.

(ii) From lung of *Morelia amethistina* (Schneider), Melbourne Zoo, in SAM No. N1980206.

(iii) From lung of *Morelia spilota* (Lacépède), Queensland, in SAM No. N1980208.

(iv) From lung of *Morelia spilota* (Lacépède), Melbourne Zoo, in SAM No. N1980172.

(v) Encysted nymph from body cavity of *Rattus leucopus cooktownensis* Tate, Queensland, in SAM No. N1980209.

Description

(i) *Female* (n = 2). Length 63 and 67, both with 31 annuli and 2 incomplete annuli on terminal segment. Hooks removed from one side of one female, AC 410; AD 625 (Fig. 1D). *Male* (n = 2). Length 21 and 22, with 40 annuli; first 12 annuli with pair of projections pointing backward from posterior lateral angles.

(ii) *Female* (n = 15). Length 34–53 (one punctured female not included) ($\bar{x}$ = 42.5), with 29–32 annuli ($\bar{x}$ = 30.6) and 2 (or in two cases, 3) incomplete annuli on terminal segment. Hooks from a 49 mm specimen, AC 440; AD 635.

(iii) *Female* — mature (n = 1). Length 47, with 32 annuli (plus two incomplete segments terminally). *Female* — immature *(n* = 4). Length 16–27 ($\bar{x}$ = 19), with 29–32 annuli (plus 2 incomplete). *Male* (n = 3). Length 16–17, with 36–37 annuli, anterior 11–12 bearing backward-pointing projections.

(iv) *Female* (n = 1). Length 46, with 32 annuli (plus 3 incomplete).

(v) *Female*(?) (n = 1). Length 6, with 31 or 32 annuli. Hooks simple but could not be measured.

Discussion

Adult specimens from the four snakes are unmistakably *A. australis* and all characters accord perfectly with those of the type series (Riley & Self 1981a). *Morelia spilota* is a new host record.

Hooks of the nymph from *R. leucopus* are simple (i.e. without an accessory spine) and the annulus count is within the range (29–35) of mature female *A. australis* (Riley & Self 1981a). The present specimen almost certainly belongs to this taxon, as other species of *Armillifer* described from Australian hosts have more annuli (Riley & Self 1981a, Riley *et al.* 1985).

Discussion

In our earlier review of pentastomid parasites in Australian reptiles and mammals (Riley *et al.* 1985) we noted that the state of our knowledge of taxonomy is embryonic, and this is particularly true of the genus *Waddycephalus*. Our original finding of a double-hooked larva, which we attributed to the genus *Waddycephalus* rather than *Elenia* solely on the basis of the number of abdominal annuli, was the first implication of mammals as intermediate hosts in this genus.

This single male larva, from the mesentery of *Satanellus hallucatus* was cleared and mounted (Fig. 1B) and we observed that the sharp spinous extension overlying the hook appeared to be an integral part of it and separate from the fulcrum. This is unlike the situation in the related genus *Sambonia* where the accessory spine is clearly an extension of the fulcrum (Fain & Mortelmans 1960). The relative abundance of nymphal *Waddycephalus* material in the present study has permitted more detailed observations of hook morphology and these have confirmed our earlier interpretation. The spine is a functional part of the hook. It possesses an apodeme, onto which muscles attach and extend from it down into the fulcrum (contrast Figs 1C and D). The relative positions of the hook, its spinous extension and the fulcrum are presented diagrammatically (Fig. 2).

The seven species of *Waddycephalus* currently recognised in Australia infect boid, colubrid and elapid snakes (Riley & Self 1981b) which prey upon a variety of vertebrates (mostly frogs, lizards or mammals — see Cogger 1983) and the present report of *Waddycephalus* nymphs from these three classes of vertebrates is to be expected, particularly since vertebrate intermediate hosts are usual in porocephalid life-cycles (Nicoli & Nicoli 1966). Also, there is growing evidence from experimental infections (Esslinger 1962, Vargas 1970, Winch & Riley 1986), and from recoveries of nymphs in intermediate hosts (Sachs, Rack & Woodford 1973), that the definitive number of annuli is present in porocephalids by the infective stage. Our tentative diagnoses are based on the assumption that this occurs in the genus *Waddycephalus*. From the viewpoint of host dietary regimen, it is equally likely that the related genera *Parasambonia* and *Elenia* also utilize vertebrate intermediate hosts but in all cases, experimental evidence of these life-cycles is required.

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LOOKING FOR DITJI-MINGKA

L. A. HERCUS

L. A. HERCUS 1987. Looking for Ditji-mingka. *Res. S. Aust. Mus.* 21(2): 149–156.

Ditji-mingka was an important Aboriginal site in the north-east of South Australia. The present paper contains a Wangkangurru text describing what has happened to this site.

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Ditji-mingka, 'Sun-Cave' (lit. 'Sun-Hole'), south-west of Etadunna on the Birdsville Track in north-eastern South Australia, was one of the most important places in Diyari mythology. Evidence of this comes from J. G. Reuther who worked for eighteen years (1888–1906) as a missionary amongst Diyari and neighbouring people at Killalpaninna on the lower Cooper. There was nobody who could rival the achievements of the Reverend Reuther in documenting the languages and traditions of the Lake Eyre Basin. Without his great work of fourteen volumes, recently translated by P. Scherer (Reuther 1981), much information would be totally lost. He gives the following account of the *Ditji-mingka* site in his list of place-names.

> *Ditji* = 'sun'; *minka* = 'cave'.
> 'There is a cave at this spot, where the female sun *muramura* is said to have first risen. But since she made conditions too hot for her followers ('people') she wandered inside the earth towards the east and has been rising there ever since' (Reuther 1981; VII: 29).

There are two expanded accounts of the *Ditji-mingka* story given by J. G. Reuther (1981, VIII: 20 and X: 20). In the latter he describes how *Ditji*, the Sun, was one of the two wives of the Wild Onion Ancestor 'Jelkabalubaluna' (i.e. *Yalka parlu-parlunha*, 'a wild Onion peeled'); *Ditji* crawled into the earth at *Ditji-mingka*. He makes other references to the site; the most telling of these is in XI: 163 where he describes 'the enchantment of the sun', i.e. a form of magic for creating hot weather. This magic was carried out with the use of *'ditjipupara'* (earth from *Ditji-mingka*). Reuther adds: 'Everyone who is a devotee of the female *muramura*, Ditji, has some of it in his wurley' (1981, XI: 163).

There can thus be no question about the importance of the site. The Reverend Reuther — as is clear from Wangkangurru evidence — usually gives a 'cleaned up' version of mythological traditions. We cannot be certain whether he himself censored the myths, or whether Aboriginal people, who respected him, were reluctant to tell him things they knew would offend him. His accounts are dull and humourless: all the spice has been taken out. There was certainly more to the story of *Ditji-mingka* than he implies, and there were associated rituals. The police trooper Samuel Gason was the first to publish details of Diyari traditions. He was not a missionary, but after all, he lived in the Victorian era. He was clearly shocked by the Sun rituals and gives the following version:

> 'Their traditions suppose that man and all other beings were created by the moon, at the bidding of the Mooramoora. (This term simply means "Ancestor"). Finding the emu pleasant to the sight, and judging it to be eatable (but unable, owing to its swiftness to catch it during the cold that then prevailed), the Mooramoora was appealed to to cast some heat on the earth so as to enable them to run down the desired bird. The Mooramoora, complying with their request, bade them perform certain ceremonies (yet observed, but too obscene to be described), and then created the sun' (Gason 1879: 260).

Other versions of the sun-legend, all involving *Ditji-mingka*, the cave of the sun, are given by Siebert (1910: 44–45) and by Howitt (1904: 427). Aiston gives yet another, different account of the Sun History, in which the Sun Ancestor is regarded as male. The cave however still figures prominently:

> 'The moora, however, escaped, but so annoyed was he, that he sank and sank, until at last, at the place now called in memory of the event Ditchaminka, he plunged into the ground. To this day is shown the hole in the stony plain where the sun disappeared' (Horn & Aiston 1924:131).

Diyari rituals gradually fell into oblivion because of the disintegration of the group and because of pressure against 'paganism' from the missionaries. Nevertheless the myth and the knowledge of the *Ditji-mingka* site did not immediately fade from the minds of Diyari people. H. K. Fry (1937: 189–194) published a brief Diyari text, with English translation, of a myth called 'Ditji-mingka Mura and Pinja, Sun Cave Mura Revenge'. Apart from the name in the title, this text does not actually mention that the female Sun Ancestor is involved. There can however be no doubt that it is an

uncensored version of the same myth as in Reuther (1981, X: 20): the Old Woman in Fry's story, like Reuther's 'Ditji', is one of the two wives of the Wild Onion Man 'Jelkapalupaluna'. This text was given to Fry and Vogelsang by an old Diyari man 'Sam' Dintibana Kinjmilina, who owned the myth at that time, in the mid-1930s. Sam also told Fry that he had a 'sun-bag' filled with light blue earth from *Ditji-mingka* which he claimed could be used to 'sing the sun and make it very hot' (Fry 1937: 193).

It is of the nature of cult-heroes that they may be larger and more extreme than the ordinary things of life. The female Sun Ancestor and her older sister in Sam Dintibana's story certainly were: they are depicted as grotesque and fearsome old women who got their husband 'Jelkapalupaluna' killed, cut him into small pieces and mutilated the body, and then mutilated themselves. The Diyari text only gives us an outline, but we can begin to imagine why the full story does not appear in Reuther's work and why Gason was shocked. The important matter is that despite the missionary disapproval of earlier years, the myth was still alive in the 1930s in Sam Dintibana's mind. Even after Sam's death the knowledge that *Ditji-mingka* was a special place, a ritual centre, lingered on and the older people with Diyari associations had a deep affection for it. This became clear to me over the years that I was travelling on the Birdsville track for language work at both Marree and Birdsville.

Ditji-mingka was often mentioned by Mick McLean *Irinjili*, by Jimmy Russell *Wanga-mirri* ('Many mornings'), and also by Ben Murray *Palku-nguyu* ('One mass of clouds'). Whenever we headed north on the Birdsville track we would pass Blaze's Well, a well which is now totally silted up. It was in a small depression which they called *Thidna-kurduni* ['Making a (deep) Footprint'] because it was there that *Ditji*, the Sun Ancestor, stepped into muddy ground while looking for wild onions. As we continued north towards Cannuwaukaninna Bore those older men would point nostalgically towards the west, saying: 'Over there is *Ditji-mingka*'. Mick and Jimmy were Wangkangurru, Ben's mother was Arabana, but they had all been associated with Diyari people (Hercus 1980, 1986; Austin 1981). They had learnt from them to admire the cave of the sun and were anxious to see it again. They often described it: it was in one of the more inhospitable areas on Etadunna station, in rough country. It was high up on the western slope of the ridge that faces the bed of the *Ditji-mingka* creek as it nears Lake Palankarinna. There was a soakage in the creek nearby and the old people used to camp there for their ceremonies (see Fig. 1).

The walls and the ceiling of the cave were of glistening gypsum which reflected the last rays of the setting sun: it was the home of the sun. There were rock-carvings inside, circles which symbolised the sun; Jimmy Russell had seen them. The two

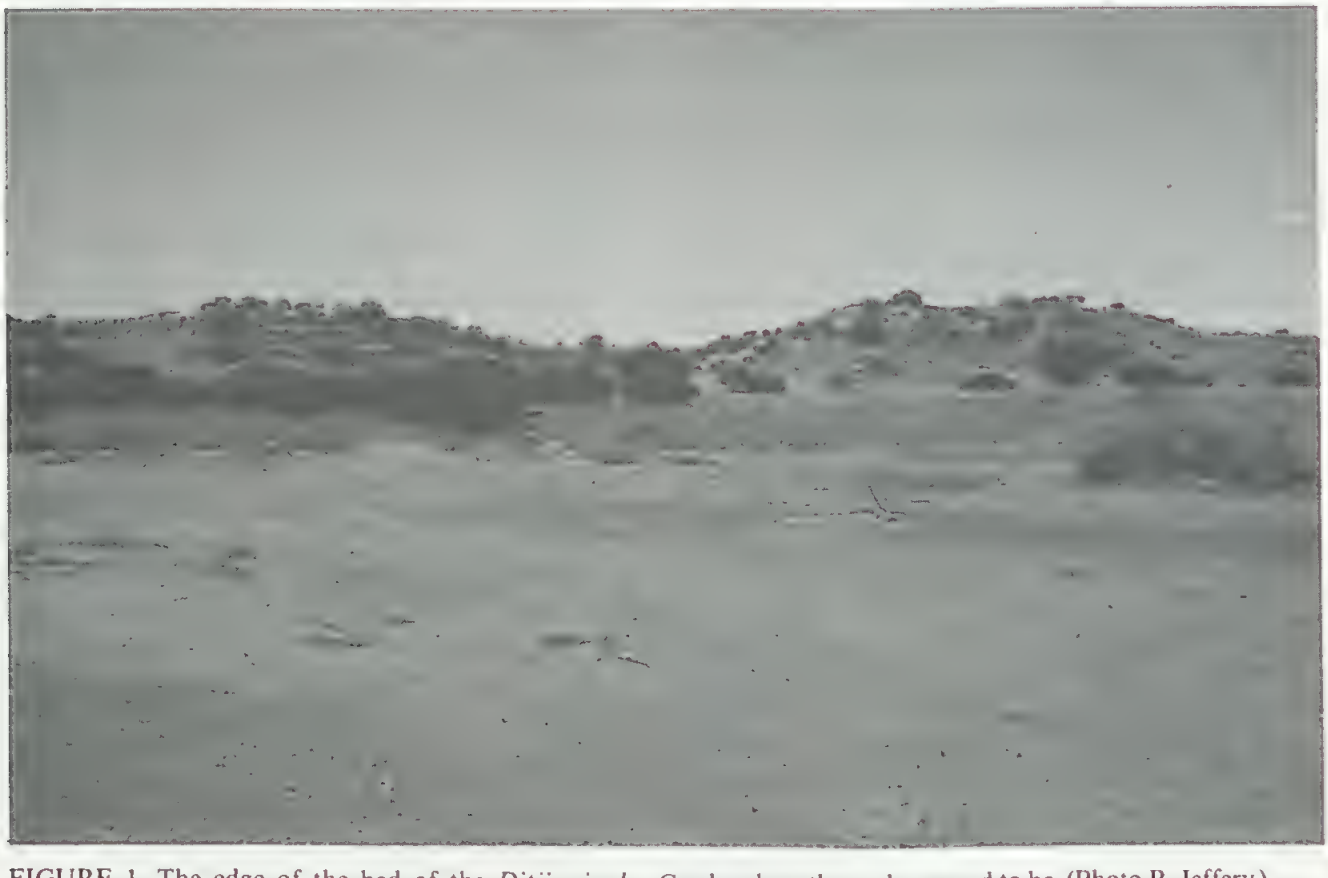

FIGURE 1. The edge of the bed of the *Ditji-mingka* Creek, where the soakage used to be. (Photo B. Jeffery.)

cave-openings were slightly upward; this meant that occasionally animals, particularly feral goats, fell in and died, not being able to get out again. It was a haven for snakes and this irritated the owners of nearby Etadunna station. Mick McLean and Jimmy Russell spoke of the cave so often that I wrote letters to have it protected; *Ditji-mingka* was truly a site of significance. Moreover it was only a few miles from Lake Palankarinna which was a declared geological reserve because of important fossil finds (Rich, van Tets & Knight 1985: 46 ff).

We were determined to see *Ditji-mingka* and tried a number of times in the early 1970s. Mick McLean was then well over eighty years old, he could not scramble up over the ridge, and on our own we failed to find it despite his instructions. Next time in August 1974, Jimmy Russell came to help, he was only in his seventies and his sense of direction was uncanny, like Mick's. He was deeply ashamed, because he too could not find it. Later of course it became clear why! Finally in June 1976 we had quite a group of people, which included Jimmy Russell and Ben Murray, as well as members of the South Australian Government's Aboriginal Heritage Unit, along with linguists Tamsin Donaldson and Peter Austin who was then writing his grammar of Diyari (Austin 1981). We again went looking for *Ditji-mingka* (see Fig. 2). Later in camp Jimmy Russell spoke in Wangkangurru about what happened:[1]

Text

1. thika-rna	*arniri*	*wadna-ya-rna*	*Itatinha*	*yadla-ku*
Come-IMP	we	run -SP-IMP	Etadunna	close-DAT

kari-rnda	*uta*	*arniri*	*yani-ngura*	*mudlu-nga-thu*	*arniri*
see-PRES	now	we	say-CONT	sandhill-LOC-EMPH	we

marrili	*tharni-thika-lhuku*	*Ditji-mingka-ruku*	*mingka*
this side	eat-return-PURP	Ditji-mingka-ALL	cave

nhanhi-lhiku.
see -PURP.

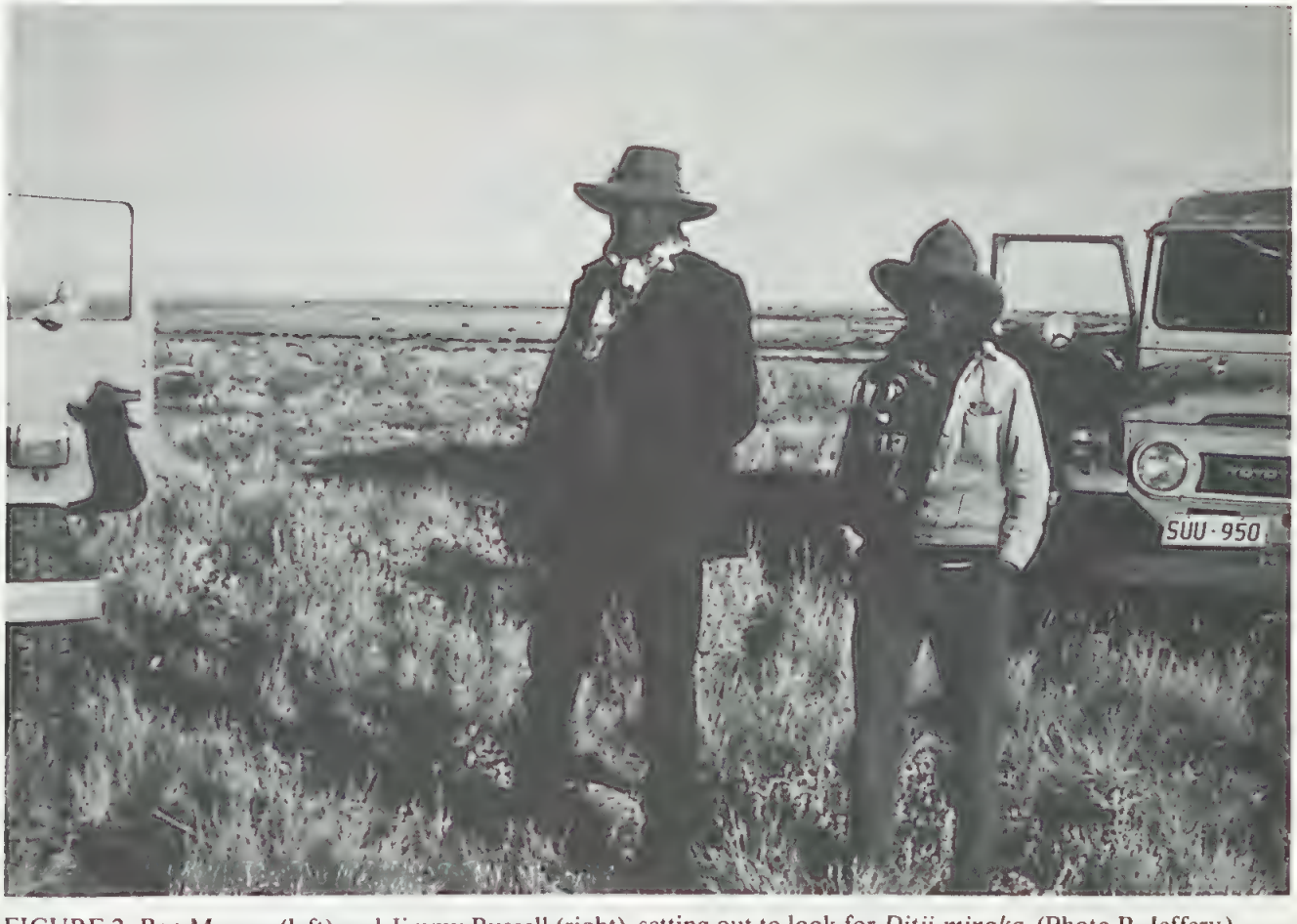

FIGURE 2. Ben Murray (left) and Jimmy Russell (right) setting out to look for *Ditji-mingka*. (Photo B. Jeffery.)

2. *wantali* *yurrakati-nga* *thika-lhuku arniri* *yuka-lhuku.*
Separately west side-LOC come-HIST we go -HIST.

intja Ditji-mingka?
Where *Ditji-mingka*?

3. *arniri* *yuka-ka* *partjarna* *wadlhu* *yurrakati-nga*
We go -PAST all place west side -LOC

thika-lhuku *arniri,* *wadlhu* *pidla* *Thita-pulumanha.*
return-HIST we, place name *Thita-pulumanha.*

4. *uta* *arniri* *partjarna* *karla-nga* *pathara* *midla-nga,*
Now we all creek-LOC box tree nose-LOC,

thidna-ra -ki *yuka-rna* *mingka-thu* *wapa-rna* *thika-rna*
foot-CAUS-EMPH go-IMP cave-EMPH seek-IMP come-IMP

thadna-rna, *wadni-rnda* *watungunta* *nguthi* *thika-lhuku.*
leave-IMP, follow-PRES rest reverse come-HIST.

5. *nhararda* *waru* *katha-liparna,* *ipali* *katha-rna,*
Here long ago walk-ANC, before walk-IMP,

malka-thu *mingka* *nhanhi,* *Ditji-mingka.*
not-EMP cave see, *Ditji-mingka.*

kutha *irtjirtja* *thuntiripa-rna* *kutha* *kathiwiRi-ri*
Water soakage cover over-IMP water big -ERG

tjiRi-ri.
flood-ERG.

padni-li *punga* *nhanhi-ra,* *thanpi-liparna* *thiRi-ri*
Not-ADV humpy see-PUNC, knock down-ANC flood-ERG

wanpa-rna.
carry -IMP.

6. *kayi kadnha* *awukinta* *kadnha arniri* *wadna-yi-rnda.*
Here rock this-ALL rock we run-TR-PRES.

yadla *witji-yangu,* *ayi!* *tjarlpa* *tharka-tharka-rnda*
close become-PLUP, hey! tree stand-stand-PRES

nhararda *yadla...*
here close..

7. *thanpi-thanpi-la-rda* *Ditji-mingka!*
Destroy-destroy-ALT-PRES *Ditji-mingka!*

8. L. What was it like before?

J. *ngurka*	*arla,*	*parluru.*	*antha*	*iparli*	*katha-nangka-rda*
Good	true,	smooth.	I	before	travel-CONT S-PRES

marna	*parkulu*	*nhanhi-ka*	*ngurku-nhaku!*	*kanhangarda*
mouth	two	see-PAST	good-EMPH!	There

mingka	*tharka-tharka-rnda*	*mingka-rda.*
cave	stand-stand-PRES	gape-PRES.

9. antha nguyu	*katha-liparna*	*nhantu-ra,*	*marna-nga*
I alone	travel-ANC	horse-CAUS,	mouth-LOC

tharka-rnda.	*mintji-mintji-rnda,*	*muyu*	*katinari*	*yantakara*
stand-PRESS.	Shine-shine-PRES,	sun	beyond	west

muyu	*mintji-ya-ra.*
sun	shine-TR-PUNC.

10. malka	*antha*	*wintaku-ra,*	*antha*	*nguyu-nguyu.*
Not	I	go in-PRES,	I	alone-alone.

kutju-ru	*pirda-lira*	*nguyu-nguyu*	*mingka-nga.*
kurdaitcha-ERG	kill-LEST	alone-alone	cave-LOC.

11. antha	*thadla-ra*	*waya-rna,*	*thadla*	*nhinka-rna-li.*
I	fear-CAUS	want-IMP,	frightened	squint-IMP-EMPH.

mintji-mintji	yalkiri-ri.	muy	round one.
shine-shine	kopi-INST.	Sun.	

12. thanpi-thanpi-rda,	*partjarna*	*thanpi-la-rda*
Knock down-PRES,	all	destroy-ALT-PRES

parluru-ku
level-DAT.

Translation

1. We came back (from looking at the lower Cooper) and drove in close to Etadunna. We had a look around and then started saying 'we'll have our lunch this side of the sandhill and then go to *Ditji-mingka* to have a look at the cave.'
2. (We split up) and walked separately coming and going over the west side of the sandhill. Where is *Ditji-mingka*?
3. We went all over the country on the west side and back again, that area is called *Thita-pulumanha.*
4. Then we all walked around in the creek bed, where the box-trees run out to a point. We were going about on foot, looking for the cave, we went and turned back again, we left, we followed the others but they came back as if they had got to a dead end.
5. I used to travel around here long ago, but I can't see that cave, *Ditji-mingka.* The soakage had been washed out by big rains, by flood-waters. I couldn't see the humpies (that had been there), they must have been knocked down and carried away by the floods a long time ago.
6. 'Ah, here is that rock!!' (I said). So we all ran straight over towards the rock. We got near: 'Ah, that tree is standing over there, we're really close!'
7. They have blown up *Ditji-mingka*!
8. L. What was it like before?
J. It was lovely, all smooth.
When I was travelling about a long time ago I saw the two openings of the cave. It was beautiful. I stood there for a while just looking at the cave.
9. I was travellng about alone on my horse, and I stood in the mouth of the cave. It was gleaming and glistening, the sun was shining in from the west.
10. I didn't go in, I was on my own. (I thought) a kurdaitcha [revenge killer] might come and kill me if I was all alone in that cave.

11. I was terrified. I peered in, very frightened. It was glistening with kopi. There was (engravings of) the sun there, round ones.
12. It has been destroyed, completely blown apart (with dynamite), razed to the ground! (see Fig. 3).

Conclusion

In 1879 Gason, as was typical of the period, had a very restricted view of Aboriginal religion, when, as quoted above he states with obvious lack of enthusiasm: 'Their traditions suppose that man and all other beings were created by the moon, at the bidding of the Mooramoora' (Gason *op. cit.*). We tend to take an equally simplistic view nowadays when we identify sites on a one to one basis with traditions: we are often told for instance in popular reporting that the destruction of a particular tree might result in the Aboriginal myth associated with it being forgotten. There is more to traditional mythology than that. This has often been said, and it was expressed with special clarity in 1965 by W. E. H. Stanner in his well-known article 'Religion, Totemism and Symbolism', where he shows the subtlety and intricacy of Aboriginal religious thought. Speaking of the totemic symbol-function he states that it has: 'four elements (i) living men (totemists) serving as interpreters of (ii) signs (totems and totem-places), by using (iii) vehicles that form and express affective conceptions of (iv) sign-objects, which are the significance of the Dream Time marvels' (Stanner 1965: 228).

If we look at these elements with regard to the Diyari Sun Myth we can see that the first to be impaired was (iii), in that the ritual, the dances, the songs and the detail of the stories fell into oblivion. Therefore (iv), the deeper symbolism, the marvel of the Dream Time Sun Myth has disappeared for ever. All we are left with is the bare outline of the story. Until recently we still had (ii) the totem-place. The situation was no worse than for much of the mythology of eastern Australia, where we usually just have minimal stories and the totem place. Although we lacked the vehicle of interpretation provided by the chants and dances, we might still have had a glimpse of one aspect of the marvels of the Dream Time through the engraving and through the appearance of the cave, but this has now gone through the destruction caused by European activity. This leaves us only with (i), the living men. For many years, since the death of 'Sam' Dintibana, there has not been anyone who 'belonged' to the Sun Myth and identified with it. There are only two people living to whom the mythology of *Ditji-mingka* and the surrounding areas still means something: they are Jimmy Russell who has suffered a major stroke and Ben Murray who is now in his nineties. Therefore it is sadly true that soon there will be no one who can stop on the Birdsville Track at the right spot south of Etadunna, look across to the west, and visualise that not far away is Lake Palankarinna– an expanse of white fading away into the distance into an endless plain (see Fig. 4). No one will remember the humour of the story of the wicked Old Man *Markanjangkurla* who chased the Seven Sisters across the lake and across the plain beyond and recall what he did there,

FIGURE 3. The heap of rubble that used to be *Ditjimingka.* (Photo B. Jeffery.)

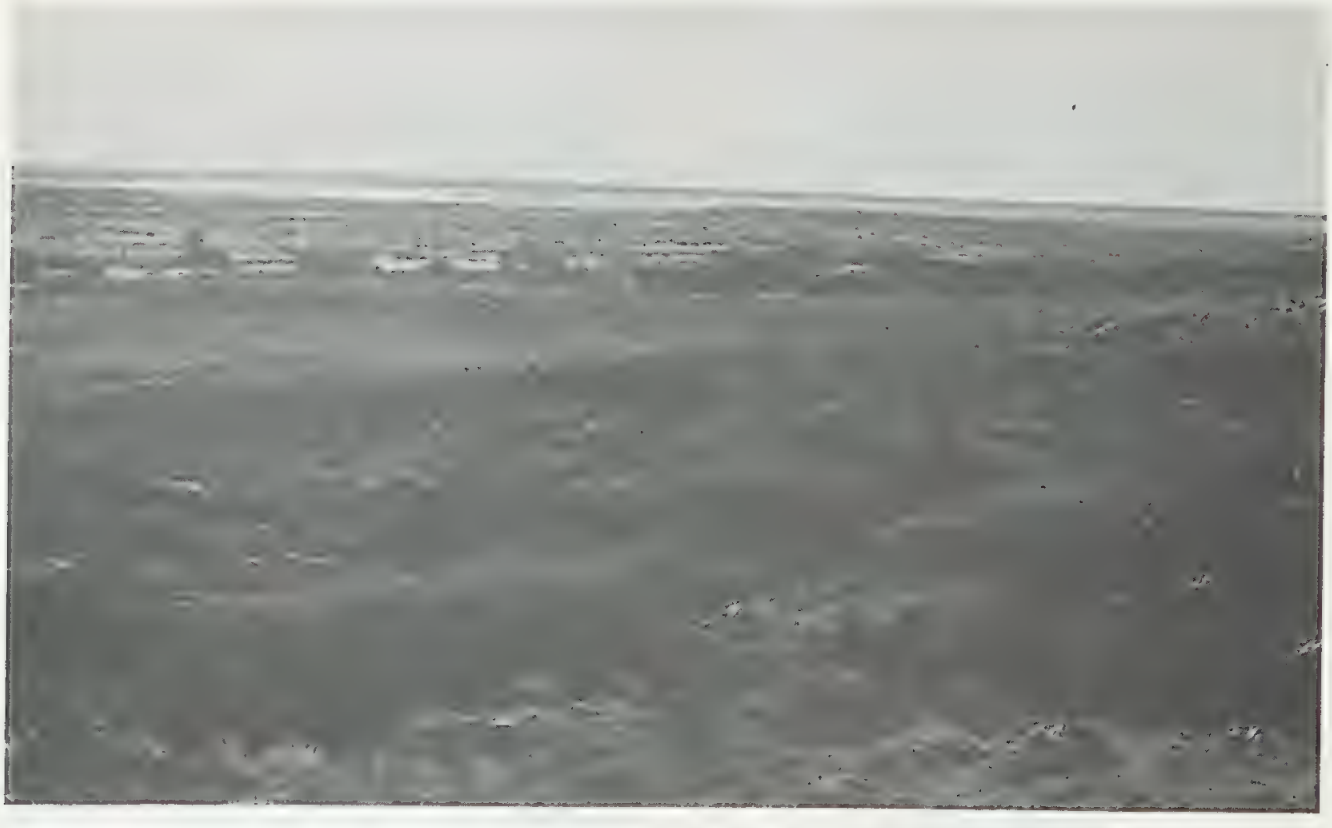

FIGURE 4. Looking towards Lake Palankarinna from near *Ditji-mingka.* (Photo B. Jeffery.)

(Lake Palankarinna, which Europeans know mainly as a fossil reserve, is really *parla-ng-kari-nha*, a crude name, since *parla* means 'semen' and *kari* means 'to chase'). Very soon there will be no one that can even visualise the cave south of Lake Palankarinna and point and say: 'Over there was *Ditji-mingka*'. We have lost the Sun Myth with all its symbolism.

Endnotes

1. The text transcribed in this paper was recorded in June 1976 as Hercus field-tape 739, a copy of which has been deposited with the Australian Institute of Aboriginal Studies, Canberra. For ease of reference the text has been split into numbered sections. The divisions are on the whole in accordance with intervals in speech. In this paper a practical orthography has been used for Wangkangurru: Plosive consonants other than the retroflex plosive have been written as unvoiced (*k, p, th, t*), but prestopped consonants have been written with voiced plosives as this corresponds most closely to the pronunciation, hence *bm, dn, dnh, dnj, dl, dlh.*

Retroflexes have been written as *r* + consonant, i.e.
rl is retroflex *l*
rn is retroflex *n*
rd is retroflex *t*

Interdentals have been written as consonant + *h*, hence *nh, th, lh.*

Palatals have been written as consonant +*j*, hence *tj, nj, lj.* *ng* has been used for velar *n*.

The three r-sounds have been transcribed as follows:
r = the alveolar flap
rr = the trilled r
R = retroflex r.

The following abbreviations have been used for linguistic terms in the interlinear gloss:

ABL	Ablative case
ACC	accusative case
ACT	active stem-forming suffix
ADV	adverbial suffix
ALL	allative case
ALT	altruistic stem-forming suffix
ANC	ancient past
CAUS	causative case
CONT	continuous participle
CONT S	continuous stem-forming suffix
DIST	aspect showing distance
EMPH	emphatic clitic
ERG	ergative case
EXCL	exclusive pronoun
HAB	habitual aspect
HIST	historical past
IMP	imperfective
LOC	locative case
NAR	narrative past
PAST	past tense
PERF	perfect
PLUP	pluperfect
POS	possessive suffix
PRES	present tense
PUNC	punctiliar present
PURP	purposive
SP	speed form, indicating action undertaken before departing
TR	transitory aspect

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THE SCALED-SQUID *LEPIDOTEUTHIS GRIMALDII* JOUBIN FROM SOUTHERN AUSTRALIAN WATERS

The first substantiated record of *Lepidoteuthis grimaldii* from Australian waters (i.e. within the 200 nautical mile fishing zone) was by Lu & Phillips (1985) but they gave no details of specimens. The purpose of this paper is to provide more details of these specimens, in particular of one in the South Australian Museum (SAM) which was not seen by Lu & Phillips, and thus highlight this interesting record from Australian waters.

Lepidoteuthis grimaldii was first described by Joubin (1895) from two mantles from a sperm whale's stomach and from a fragment of a Risso's dolphin, both caught off the Azores. However, up until 1960 there had been only four records of this species and only two included the head (Clarke 1960) and a complete description was not available until 1962 (Clarke & Maul 1962). Since then the species has been recorded from most of the world's oceans, North and South Atlantic (Clarke 1966), Indian Ocean (Clarke 1980), Pacific Ocean between the New Hebrides and New Caledonia (Rancurel 1970), Pacific Ocean off Japan (Okutani *et al.* 1976), Tasman Sea (Clarke & MacLeod 1982) and Southern Ocean (Lu & Phillips 1985).

Complete specimens are still rare and apart from juveniles caught in nets (Clarke 1964 & 1980, Lu & Clarke 1975, Roper & Young 1975) and the record of Lu & Phillips (1985) all specimens have been obtained from the stomachs of predators, mainly the sperm whale, *Physeter catodon*, but also from Risso's dolphin, *Grampus griseus* (Joubin 1895); the lancet fish, *Alepisaurus ferox* (Rancurel 1970); the black-scabbard fish, *Aphanopus carbo* (Clarke & Maul 1962) and the tuna, *Germo obesus* (Clarke & Maul 1962).

The first published evidence that *L. grimaldii* might occur in Australian waters was provided by Clarke (1980) who recorded the buccal mass of two specimens from the stomachs of sperm whales caught by whaling ships operating out of Albany, Western Australia. Clarke & MacLeod (1982) also recorded the remains of specimens from the stomachs of sperm whales killed in the Tasman Sea between 33°S, 172°E and 40°S, 155°E but this is at least 550 km south-east of Cape Howe, eastern Australia. The Australian specimens referred to by Lu & Phillips (1985) and the one in SAM are noteworthy in that they are the first records of adults from other than predators' stomachs and indicate that the species occurs relatively close inshore along the south coast well within reach of commercial trawlers.

Details of specimens are as follows:

1. Male, 122 mm dorsal mantle length, 97 km east off Broken Bay, New South Wales (33° 28′ S, 152° 33′ E), depth 0–1000 m, Engel mid-water trawl, FRV 'Kapala', J. Paxton, 14 December 1977 (Australian Museum, Sydney AM, C111782).
2. Sex undetermined (viscera missing), 755 mm mantle length, approx. 50 km south-west off Beachport, South Australia, trawled in 550 m by 'Margaret Phillipa', 6–10 September 1982 (Museum of Victoria MV, F53159).
3. Sex undetermined (viscera decayed), 790 mm dorsal mantle length, approx. 40 km south-west off Beachport, South Australia, trawled in 220 m, obtained fresh from fish processor in Portland, Victoria by W. Zeidler, 22 October 1981 (SAM, D17589).

Specimen 1, a juvenile, is in relatively good condition and only the tips of the arms are missing. Generally it agrees with the description of young stages given by Clarke (1964) and some body measurements are given in Table 1.

TABLE 1. *Lepidoteuthis grimaldii* body measurements.

Character	Measurement (mm) Specimen 1	Specimen 3
Mantle length (dorsal)	122	790
Mantle length (ventral)	115	740
Mantle width (max)	26	210
Fin length	60	410
Fin width (max)	50	240
Gladius length	-	790
Gladius width (max)	-	63
Rachis length	-	480
Rachis width (max)	-	28
Max. width of scales	1.5	10

Specimen 2 is too damaged for accurate measurements.

Specimen 3 (Fig. 1) when collected was in good condition with only the tips of the arms missing. However, it was inadvertently left out of the freezer and deteriorated considerably before being measured and preserved. The head is too damaged for accurate measurement, other body measurements (Table 1) are according to Roper & Voss (1983) and beak dimensions (Table 2) are according to Wolff (1984). Some measurements are inaccurate due to the damaged nature of the specimen e.g. the fins are contracted, dorsal mantle length probably is longer as the tip of the tail is damaged and about 70 mm is missing and the mantle is probably not as wide when all internal

FIGURE 1. Ventral view of *Lepidoteuthis grimaldi*, SAM, D. 17589.

organs are intact. The beaks (Fig. 2a–c), radula (Fig. 2d) and gladius have been adequately described for this species by Clarke & Maul (1962) and the SAM specimen does not differ from that description.

TABLE 2. *Lepidoteuthis grimaldii* (SAM, D17589) beak dimensions.

Character	Measurement (mm)
Upper	
Hood length	39.5
Rostral length	17.6
Wing width	9.5
Rostral tip to inner margin of wing	26.0
Wing to crest length	43.2
Crest length	59.6
Jaw angle width	10.0
Lower	
Rostral tip to inner posterior corner of lateral wall	41.2
Rostral length	17.3
Rostral tip to inner margin of wing	35.2
Wing length	18.3
Jaw angle width	9.3

Acknowledgments

I wish to thank Ian Loch, The Australian Museum, for the loan of Specimen 1, Dr C. C. Lu, Museum of Victoria, for information on the MV specimen and for his constructive criticism of the manuscript and John Glover, SAM, for providing common names of fish predators. The photographic expertise of Roman Ruehle (Fig. 1) and Jan Forrest (Figs 2 and 3), both of SAM, is also gratefully acknowledged.

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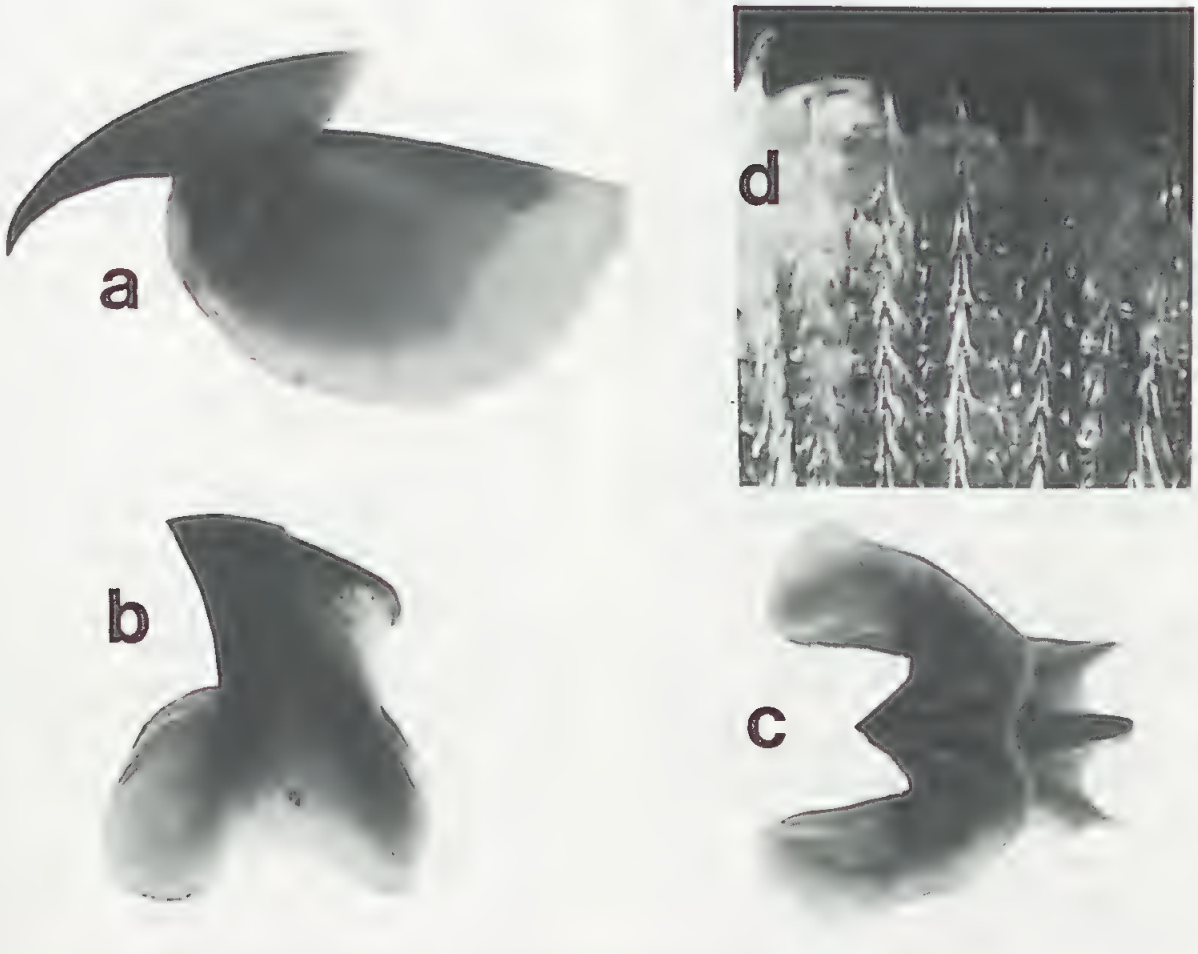

FIGURE 2. *Lepidoteuthis grimaldii* (SAM, D17589); a. Upper beak; b, c. Lower beak; d. Radula.

REVIEW

FROM HORIZONTAL TO PERPENDICULAR: TWO RECENT BOOKS ON CENTRAL AUSTRALIAN ABORIGINAL PAINTING

Albert Namatjira, the Life and Work of an Australian Painter by Nadine Amadio, Anne Blackwell, Jonah Jones & Daniel Thomas. Macmillan, Melbourne, 1986. ix + 102 pp. illus. Cloth only. $A29.95.

Dot and Circle: a Retrospective of the Aboriginal Acrylic Paintings of Central Australia edited by Janet Maughan & Jenny Zimmer. Royal Melbourne Institute of Technology Communications Services Unit, Melbourne, 1986. 207 pp. illus. Paper only. $A20.00.

'The interaction between the European and Aboriginal artistic traditions can produce a renaissance potentially as significant for Australian life as that which was launched upon Europe by the spread of the "new knowledge" from Constantinople in the sixteenth century'. With these dramatic words Dr H.C. Coombs launches his introduction to the most recent book on the work of Albert Namatjira, compiled and edited by Nadine Amadio, arts editor of Sydney's *Sunday Telegraph*. Dr Coombs is certainly right to point out that Aboriginal graphic and sculptural imagery constitutes a distinctive body of sources for the arts in Australia generally, although their role thus far might more aptly be likened to that of African and Oceanic works in the rise of twentieth century primitivism in western European art, than to that of the manuscripts of Constantinople circa 1453. The Renaissance was, among other things, a scholarly revolution. By contrast, Picasso was able to remark, in effect: 'Everything I need to know about Africa is in those objects' (Rubin 1984: 74).

However, Albert Namatjira, on the face of it, is a reverse case: an Aboriginal person who painted in the European-Australian watercolour landscape style. The handsome new book of around 30 colour plates and nearly 40 pages of text which is part of the subject of this article begins with a 'celebration' of the painter's life by Nadine Amadio. Here we are helpfully told of the important retrospective exhibition of Namatjira's work held at the Araluen Arts Centre in Alice Springs in 1984, and curated by Mona Byrnes. This signalled a revival of interest in a painter who had become an Australian household name by the 1950s but whose reputation had never been very secure among curators and scholars of art and whose reputation declined after his death in tragic circumstances in 1959.

Amadio's chapter carries the obligatory post-1960s enlightenment regarding the falsity of applying the ordinary sense of the term 'primitive' to Aboriginal art. While bending a knee briefly to Namatjira's belatedly recognised (and poorly documented) concern with *country* and sites of mythological significance, this chapter succeeds nevertheless in rescuing and promoting Namatjira as a naive artist (my term, not hers) in another sense: instead of High Chocolate Box we now have Grandma Moses.

Amadio is especially concerned to frame Namatjira's work within the traditional key symbols of western European art mythology. He was a 'true painter' (p. 5) with his 'own vision' (p. 6), who 'knew the joy of a full creative life. He must have possessed an extraordinary drive and passion' (p. 2). His 'drive' or 'creative drive' is referred to repeatedly. Strangely posed next to this supposed 'drive' is Namatjira as Nature's Gentleman, a man whose 'dignity' and 'natural dignity' (p. 10) are to be remarked upon, and whose pictures are noted for their pellucid, airy calm and balanced repose. They are also pictures of beautiful (and largely unpeopled) landscapes, excluding even a hint of the nasty side of life available in and around the Alice Springs of his time.

Jonah Jones' short piece on the 1984 exhibition, where a remarkable 56 Namatjiras were assembled, is of particular historical value, although one could have done without the mystification of the comparison with Piero della Francesca on page 18 ('It is all there'. What is? And what is it?).

Daniel Thomas's chapter re-evaluates Namatjira's relationship to the art world. It is the best chapter by far and says some new and substantial things about Namatjira's work. He points out some major reasons why Namatjira's work was only slowly recognised by art professionals: it came out of the tourist industry; it was exhibited in unprestigious locales for much of his life; vice-regal patronage made art scholars suspicious; watercolours were strongly associated (as they still are) with amateurism; and Namatjira painted in a style that was already considered conservative and hackneyed by 'professional, vocal, modernist' artists. Yet he painted with the best of those characteristically Aboriginal artistic qualities of 'extreme delicacy, refinement, and gentleness' (p. 26). Finally, Thomas makes the important observation that Namatjira's art, which was seen in his own time as 'European',

is now 're-Aboriginalised' because of three main factors: its reference to significant country; its symbolic repetitiveness; and its fineness of touch. 'Our altered understanding permits us now to admire it more fully, and to be moved by it' (p. 26).

The other excellent chapter in the book is that by Anne Blackwell, a young archaeologist and historian who sadly was killed in a car accident in Central Australia in 1986. While Thomas' chapter excels in ideas, Blackwell's excels in historical fact. The history of Hermannsburg, the roles of Carl Strehlow and F. W. Albrecht there, the creation of the Aboriginal craft industry, the biography of Namatjira, and the emergence of a Hermannsburg watercolourist 'school', are presented with scholarly attention to detail and handsomely illustrated. It is here that we find, amazingly, the only remark on Namatjira's work by an Aboriginal person: 'That old man — he painted'. This is reminiscent of Amadio's comment about the Papunya acrylics painters on p. 13: 'Every painting they point to, they say simply, "this is my country" . . .'. Typically, a lengthy explanatory discourse or even a brief gushing eulogy or critical sideswipe is an unlikely Central Australian Aboriginal response to a question about a painting. This does not mean that extensive records cannot be made of what people know, think and feel about a picture. It does mean that much patient and laborious investigation has to be invested in the process by the outside enquirer.

Forming the last section of the book, the colour plates are perhaps the best guide to the aesthetic apparatus of lovers of Namatjira's work, because they are accompanied by captions which use phrases such as: 'richly-toned . . . warmth and sensuality . . . simple beauty of form . . . an earthy power' (p. 46); 'delicacy and economy' (p. 48); 'a gentle and lyrical painting, restrained in colour' (p. 89). Throughout evaluations like these both here and earlier in the book the recurring themes are:

1. Innocence, naivete, gentleness, restraint
2. Fineness, delicacy, tonal subtlety, economy, accuracy
3. Lightness, energy, vitality, drama, vibrancy, urgency
4. Optimism, celebration, fancifulness, warmth, sensual respose.
5. Vastness, distance, openness of space
6. Repetition.

I think this lends some weight to my suggestion that Namatjira has emerged as a naive but technically proficient and respectable painter, in the assessment of many of his admirers. In the past, it was his falsely supposed lack of sophistication which played such a commanding role in his lionisation and demotic fame among suburban Australians. His intellectual sophistication is now seen to lie in the relationship between his pictures and the geographical sites and geographical religion they represent, rather than in some happy fusion of his High Culture with his manner of representation. Had he done the same works in the 1980s, though, this may not have been the case at all.

Namatjira's is the gentle innocence and 'natural dignity' of someone 'close to the earth' and unpolluted (or just about to be polluted) by the industrial civic culture. This is not the gentleness (gentility, genteelness, gentrification, gentlemanliness) of restrained passion so characteristic of 'civilisation', where some sign of the wildness that has been domesticated must remain if art is to avoid being too wishy-washy. This is the clarity of Eden.

And I suggest, also, that this analysis might to a lesser degree apply to the generally positive response by art lovers to the Aboriginal acrylics which have so rapidly displaced Hermannsburg watercolourism from centre stage in the Centre. Technically variable but usually far from technically incompetent, the acrylics are — especially when documented — genuinely appealing depictions of the concerns of a tradition which seems free of the tired baggage of self-comment.

While Albert Namatjira painted (for sale, at least) the typically horizontal view of landscape of the European art tradition, the acrylics painters present us with images of place viewed from a perpendicular, aerial photographer's perspective.

Papunya paintings, Papunya Tula Art, Pintupi paintings, Western Desert paintings, Aboriginal acrylics, the dot paintings — the term has yet to settle down, perhaps reflecting two persistent uncertainties. One of these uncertainties rests on the fact that most of us who talk about the works have at best a partial grasp of their social and cultural location, or indeed that of any art or artefactual style in Aboriginal Australia. Another uncertainty arises from the fact that, fifteen years after the birth of the Aboriginal acrylics 'movement', it is still mainly known through exhibition ephemera, TV programmes, brief magazine articles, and small sections of survey works such as the excellent introductions to Aboriginal art by Berndt, Berndt & Stanton (1982) and Isaacs (1984).

In other words, there is no major, sustained, scholarly study of these paintings available, and which is on a scale comparable to Nancy Munn's *Walbiri Iconography* (1973) or Howard Morphy's unpublished thesis on north-east Arnhem Land bark paintings (1977). Such a study would form an authoritative basis for characterising the works. An historically oriented study of this kind is now urgently needed, for the acrylics are not only a 'style', a 'genre', a 'movement' (spreading phenomenon, at least) and an 'industry', but also a rapidly developing 'phase' in a very old graphic tradition

— in fact, the very one Munn was writing about twenty years ago.

The catalogue or book *Dot and Circle*, edited by Janet Maughan & Jenny Zimmer, lies somewhere between the handy but lightweight ephemera, which usually throws up unintegrated fragments of fact (and fiction), and the full-scale scholarly study which turns an array of facts into a body of knowledge and interpretation.

In one of its facets, *Dot and Circle* is a listing and reproduction of the 102 pictures shown in the exhibition of the same name lent by the Flinders University Art Museum to the Royal Melbourne Institute of Technology Gallery in April–May 1985. They later returned to be shown at Flinders University in Adelaide. The catalogue is valuable not only because it lists the works and their often considerable documentation, but also because it reports the exhibition itself in the form of photographs of the installation and its opening, lists of case exhibits and exhibition photographs, and a reproduction of the exhibition text labels. Inventories of the first year's consignments of acrylics from Papunya to the Stuart Art Centre 1971–2, provided here by Pat Hogan, and the appendices detailing works painted by David Corby Tjapaltjarri and Turkey Tolsen Tjupurrula while Aboriginal Artists in Residence at Flinders in 1979, may also be mere lists but they will be of much greater historical interest as time goes by.

In its other, more discursive role the book does provide a collection of brief essays on the origins and significance of the acrylics movement by a variety of authors. There is little intellectual coherence between the essayists here, however. Geoff Bardon's account of the sudden adoption of acrylic painting at Papunya during his time there in 1971, here reprinted from his 1979 work (Bardon 1979), is a reminiscence of importance to Australian art history and also a work of great honesty, even if at times it shows an unnervingly slight grasp of the culture of Aboriginal people. Dick Kimber's much more savvy recollections of the same period follow those of Bardon and very usefully cite the names of the key European supporters of the 'movement'. (As Kimber says, rather paradoxically, it is 'only a movement in European eyes accustomed to crowds rather than individuals' (p. 19).) It is clear that the acrylics are, and always have been, very much a direct product of particular Aboriginal–European interactions, not simply 'Aboriginal products' sought and bought by Europeans.

Another reminiscence in this collection, Rodney Morice's 'The Kungkayunti experience', is the exceptional essay in the literary sense — it is beautifully written, it is alive and conveys the quality of daily experience in a remote Aboriginal camp, and it rings true, as the work of someone who was there long enough and had sufficient sensibility to get it right. As a means of orienting the reader to an unfamiliar world it is excellent, even though its relation to the business at hand is rather general (and like the Bardon piece it is a reprint (in this case, from *Overland* 1978)). The heavy dominance of the overview in the presentation of the Aboriginal arts is, I hope, soon coming to an end.

Andrew Crocker's essay, 'Potential and pitfalls', promotes the view that Aboriginal works should be allowed to take 'their place in the contemporary artistic forum', and supports the view that the evolution of Aboriginal art 'enables those Aboriginal artists with an exceptional artistic flair to flourish' (p. 47), opposing the restrictive attitude of 'traditional is better'. The possibility that the Papunya paintings emerged from an assertion of traditionalism by older men sits uneasily here — it does not invalidate Crocker's view, but it does cry out for consideration.

The sections of the book which will perhaps be of greatest interest to scholars of art history and material culture are those by Janet Maughan and Vincent Megaw. (By 'material culture' here I mean to include aesthetic anthropology, as well as the less theoretically-oriented branches of that field.)

Megaw, an archaeologist by training, has published a number of papers on the Aboriginal acrylics phenomenon. This one, 'Dreamtime discipline or alien adulteration?', stresses a theme similar to that of Crocker's piece which precedes it: that the 'fine art' status achieved by Aboriginal works is legitimate, and that commercial and institutional recognition (or should it be 'constitution'?) of that fact is inevitable. People who complain of capitalist penetration of Aboriginal society via art are idealising, romanticising and attempting to fossilise its culture. Megaw suggests that change in Aboriginal art is not adulteration of a pristine, noble culture by a greedy, foreign one but a sign of Aboriginal cultural vitality in the modern world.

Like his other papers on similar themes, Megaw's essay in this case questions the rationality and the morality of distinctions such as fine art/tourist art, art/artefact, art/craft and so on, meanwhile raising the problem of applying aesthetic judgements across cultures. Several positions on these subjects are adumbrated, none of them is particularly rigorously pursued, and few of them are plumped for other than gingerly. The profession of archaeology is mentioned in an act of dissociation of the author from the philosophy of art or art criticism.

Jenny Zimmer's preface (oddly, one of two, the other being by Maughan & Megaw) provides much useful information on the creation of the exhibition itself. As a performance it must go down as one of the most orchestrally complex in Aboriginal art history. She also offers some revealing thoughts on

why such an exhibition was considered useful as part of the education of some Melbourne art students. There is not room here to argue all the points she raises, although most of them are arguable.

Her most interesting point is summarised in her last paragraph: '**Cultural Convergence** can only serve to make our culture richer and more authentic. This exhibition and booklet are dedicated to the concept of **Cultural Convergence**' (p. 13, bold print original).

Perhaps this is an implicit stand against the recent avalanche of Left criticism in this field, which resounds with phrases like 'cultural genocide', 'astheticisation' and 'neo-colonialist encapsulation'. It may also be a recognition of the fact that a new Australian sub-culture has been emerging for fifteen years or so among people of no Aboriginal ancestry, many of them resident in Central Australia. They are creating a partly new way of life, one affected by a perception of Aboriginal culture and by interaction with Aboriginal people, yet distinct. This theme is reflected in the final section of the exhibition and catalogue, which is called variously 'White artists using Aboriginal designs' (p. 18), 'The Western Desert image and the European art context' (p. 25), 'Across the cultural divide' (p. 191) and 'Across the cross-cultural divide' (p. 205).

Tim Johnson is a non-Aboriginal artist who has used graphic devices drawn from the Aboriginal acrylics and who has painted jointly with an Aboriginal artist (see cat. nos. 97, 98). Whether this is best described as 'convergence' or 'incorporation' (etc.) has been a matter of debate. Whether it has yet resulted in 'good works of fine art' has also been a matter of debate. The latest wave of European artists influenced by Aboriginal graphs can probably claim a moral, if not an aesthetic, advance over predecessors like Preston, whose contact with Aboriginal people was generally much more marginal and whose borrowing was done from photographs and museum collections rather than 'with the people'.

Not only artists but collectors and curators interested in the Aboriginal acrylics are beginning to talk of them as the first truly Australian art, *and* as a case of cultural convergence between Aborigines and European Australians. This perception, problematic as it may be, is gathering force.

I have left Janet Maughan's contribution to the end, both because it is the longest and because it is comparatively rich. She outlines the history of the genre and the referential meaning system of its images, and attempts a style analysis which, as she herself points out, fails to get off the ground (p. 17). I do not agree that such an analysis is not possible, however. The effect of variety perceivable among the pictures is great, certainly, but it is one which rests on the recombination of a limited set of motifs and of ways of placing them in a symmetrical field. The list of motifs or recurrent symbols in Figure 2 (p. 16) seems to me seriously incomplete, and also conflates sets of symbols which ought to be kept distinct. No structural typology of the images is offered, although the works are eminently suitable for this kind of first-sort. It is difficult to see how a style analysis could procede without some kind of sorting into the various kinds of axial symmetry, for example.

Maughan then goes on to discuss the major subgroups of works in the exhibition and the rationale for their subgrouping, beginning at the beginning (the early paintings), and moving on to look at two artists specially represented in the exhibition, Tim Leura Tjapaltjarri and Toby Brown Tjampitjinpa. This concentration on two individuals was important to establishing an idea of the style and output of particular artists over time.

Institutional roles in the acceptance and promotion of Aboriginal acrylics are highlighted here. The particular efforts of Visual Arts staff and students at Flinders University are given their due, though for better balance there could have been more emphasis, for example, on the historic role of Robert Edwards and the Aboriginal Arts Board in promoting both the production and the sale or public collecting of these works in the 1970s and 1980s.

'Children's paintings' (for, not by) come next, followed by 'Women's paintings' (by, not for), where it is made clear that women are under-recognised as painters in the genre and tend to produce for the 'craft' market. The question of how much this may be a reflection of gender roles in matters of religious authority is not opened up.

Maughan ends by relating Papunya paintings to conceptual art, but, in the absence of a discussion of what that is, many readers may find the connection obscure. It is a pity there was not room enough in her essay for a substantial discussion of the relation of the acrylic designs to those largely very similar ones of the same region which have been recorded since the earliest European times, but in other media: the rock intaglios, rock paintings, body decorations, shield designs, and the sand drawings of daily conversation and play.

Among Maughan's more interesting observations are the view that the complexity of figure-ground relations in the acrylics has increased over time, and her important statement that there is a gaping lack of published information on Aboriginal criteria for merit in paintings. Great credit is due also for her long and detailed work on the catalogue annotations.

The production quality of the book leaves much to be desired, but most of my reservations there

would have been pre-empted by more generous publication funding of typesetting and layout, printing and binding. The page size (A4) is unattractive; it needs to be more squat. The 13 colour plates are fine but the monochrome plates are rather muddy. In one case a signature has been chopped in half (p. 104) and in another the alignment marks have intruded (p. 111). Lines wobble.

Perhaps more serious are editorial lapses such as uncaptioned plates (pp. 1, 4, 8, 12, 41, 48, 93), typographic errors, and the entirely wrong information under the plate on p. 20 which says: 'Western Desert: Demonstration of circular designs which have in part replaced the more complex traditional ground paintings. Photo: Penny Tweedie.' This is actually a photograph by C.P. Mountford taken at Haasts Bluff in 1942. This mistake is perhaps partly compensated for by the humour value of the caption to the upper photo on p. 46: 'Old Mick Tjakamarra with Daphne Williams recording the story of the painting, 1982. Photo: Vincent Megaw'. Ms Williams, apparently short of paper, is on close inspection writing down the details in her Bank of New South Wales cheque-book. . .

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RECORDS OF THE SOUTH AUSTRALIAN MUSEUM

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FOSSIL MOLLUSC TYPE SPECIMENS IN THE SOUTH AUSTRALIAN MUSEUM

1. POLYPLACOPHORA

K. L. GOWLETT-HOLMES & B. J. MCHENRY

- 8 AUG 1988

GOWLETT-HOLMES, K. L., & MCHENRY, B. J. 1988. Fossil mollusc type specimens in the South Australian Museum. 1. Polyplacophora. *Rec. S. Aust. Mus.* **22** (1): 1–11.

The South Australian Museum collection of fossil chiton types is the largest in the southern hemisphere. It contains primary type material, and some secondary types, of 63 species and subspecies. A further species is represented only by secondary types. All species are from the Tertiary strata of Victoria, South Australia, Tasmania and New Zealand. Species are listed alphabetically according to the original name of the genus or species.

K. L. Gowlett-Holmes & B. J. McHenry, South Australian Museum, North Terrace, Adelaide, South Australia 5000. Manuscript received 19 February 1987.

Most of the fossil chiton types in the South Australian Museum are due to the work of E. Ashby, mainly in conjunction with B.C. Cotton and W.G. Torr. Other fossil chiton types are the result of the work of Cotton & Godfrey. Since Cotton & Godfrey (1940) little has been published on Australian fossil chitons, and no further types have been added to the collection.

We believe that the South Australian Museum collection of fossil chiton types is the largest in the southern hemisphere and one of the more significant collections in the world. It includes type material for 64 species or subspecies, all of which have been verified by us according to available material and information. The specimens are all individual valves, and are listed as 'complete' when the insertion plates and sutural lamina are present, as 'incomplete' when these are missing or the valve slightly damaged, or as 'fragment' when less than half of the valve is present in one piece.

In the following list, species are arranged alphabetically in families under the original name at the time of description. Changes in familial status have been cross-referenced. The present status of each species is, unless indicated otherwise, according to van Belle (1981), except that the family Afossochitonidae is not recognised following Gowlett-Holmes (1987). The following abbreviations are used in the text. NMV = Museum of Victoria, Melbourne; N.Z. = New Zealand; S.A. = South Australia; SAMA = South Australian Museum, Adelaide; Tas. = Tasmania; Vic. = Victoria.

Stratigraphical Notes

All fossil chiton types in the South Australian Museum come from the Tertiary strata of Victoria, South Australia, Tasmania and New Zealand, ranging from early Miocene to late Pliocene (Tables 1, 2). During this study it was noticed that there were several inaccuracies and ambiguities in the geological data of the original type descriptions, so it is necessary to make some corrections and clarifications at this stage. According to Johnston (1877), the fossiliferous beds at Table Cape, Tasmania, occur at two small bluffs near the township of Wynyard. The Table Cape Group exposed here includes two formations; the Freestone Cove Sandstone (the 'Crassatella Beds' of Johnston) which grades upwards into the overlying Fossil Bluff Sandstone (Banks 1962). Ashby (1929) proposed the 'Lower Bed' at Table Cape to be the type locality and horizon for *Loricella gigantea* Ashby & Torr, 1901. Quilty (1972) refers to 'chiton plates in the lower six inches' of the Freestone Cove Sandstone and we believe this to be the level from which the Ashby specimens were collected. At that time, the age of the fossil deposits at Table Cape was thought to be Eocene (Johnston 1880, 1885; Pritchard 1896) and was until quite recently believed to be Janjukian (Banks 1962). Later studies (Quilty 1966; Ludbrook 1967a, 1973) have shown these strata to be Longfordian, thus the Janjukian age of the Table Cape chiton types needs further consideration.

The original description of *Lepidopleurus clifdenensis* Ashby, 1929 states that this species is from Clifden at the southern end of the South Island of New Zealand and is Hutchinsonian (basal early Miocene) in age, but no stratigraphical data are supplied. Both B.L. Wood in Suggate *et al.* (1978) and Ludbrook (1967b) indicate that Hutchinsonian strata at Clifden are most likely the Clifden Limestone, and so we believe this to be the formation from which this species was collected.

The fossil locality at Gellibrand River, Victoria, occurs in either the Longfordian–Batesfordian Gellibrand Marl or the underlying Janjukian Longfordian Clifton Formation. Both of these units crop out on the

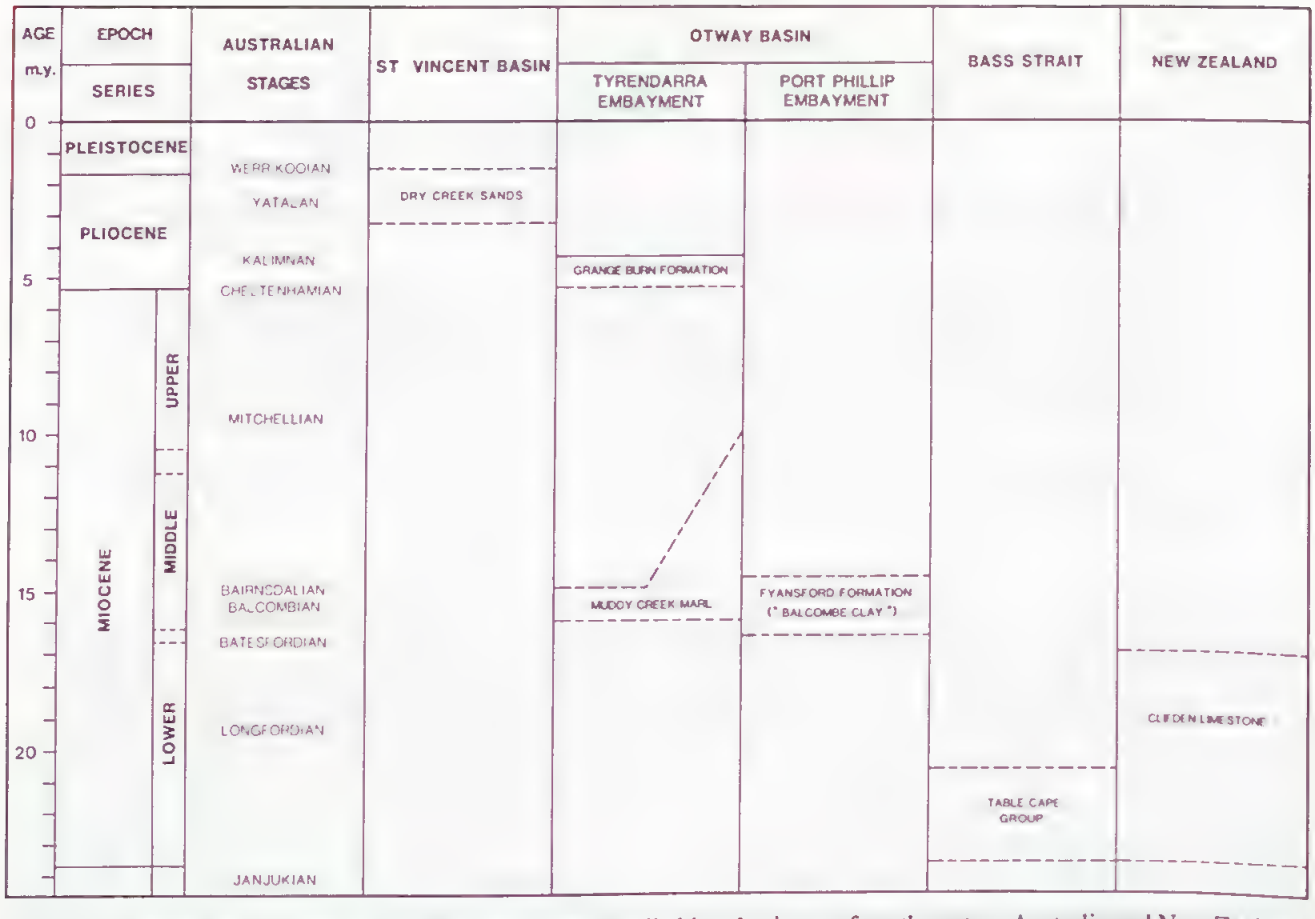

TABLE 1. Generalised correlation chart for the relevant fossil chiton horizons of south-eastern Australia and New Zealand.

ADELAIDE PLAINS DRY CREEK SANDS UPPER PLIOCENE	MACDONDONALDS, FORSYTHS GRANGE BURN FORMATION MIDDLE PLIOCENE	CLIFTON BANK MUDDY CREEK MARL MIDDLE MIOCENE	MORNINGTON BALCOMBE CLAY LOWER MIDDLE MIOCENE	BASS STRAIT TABLE CAPE GROUP LOWER MIOCENE	NEW ZEALAND CLIFDEN LIMESTONE LOWER MIOCENE
Acanthochiton (Eoplax) adelaidae *Chiton (Anthochiton) tricostalis relata* *Cryptoplax ludbrookae*	*Acanthochiton drunus* *A. forsythensis* *A. (Lirachiton) inexpectus* *A. singletoni* *A. triangulodes* *Aflosochiton (Telochiton) magnicostatus* *A. sulci* *Anthochiton duodeni* *A. macdonaldensis* *A. octocostatus* *Cryptoplax numicus* *C. sicus* *Callistochiton greedi* *C. inexpectus* *C. reticulatus* *Callochiton macdonaldi* *Isochnochiton cossyrus* *I. durus* *I. neglectus* *I. numantius* *I. tisurus* *I. valenae* *I. vinazus* *Belchiton pulchemmus* *Lepidopleurus babidus* *L. badioides* *L. sephus* *L. sinervus* *L. singus* *L. uxellus* *Molachiton naxus* *Loncella concava* *L. magnipustulosa*	*Acanthochiton casus* *A. pilsbryoides* *A. sabratus* *Aflosochiton cudmorei* *A. (Telochiton) dendus* *A. (Telochiton) iscus* *Callistochiton reticulatus* *Ischnochiton (Rasiella) cliftonensis* *Lepidopleurus badioides* *L. diversigranosus* *L. magnogranifer* *L. nivarus* *L. pamphilius* *L. relatus* *Aulacochiton erma* *Lonica oculea* *L. varena* *Oochiton halli*	*Acanthochites (Notoplax) granulosis* *A. rostratus* *Acanthochiton balcombiensis* *Callochiton (Ocellochiton) sulci*	*Chiton fossicus* *C. paucipustulosa* *Lonica affinis* *L. compressa* *Loricella gigantea*	*Lepidopleurus clifdensis*

TABLE 2. Geographic and stratigraphic distribution of SAMA fossil chiton types. Species are listed under their original names, see text for changes and synonymies.

coast of western Victoria approximately 1 km north of the mouth of the Gellibrand River (Abele *et al.* 1976). Although the type specimens of *Plaxiphora concentrica* and *P. gellibrandi* were designated as coming from this locality, subsequent examination of the valves by the authors has led us to believe that the specimens are in fact recent examples of the living species *Plaxiphora (P.) albida*, and not fossil remains at all.

Species described from Mornington, Balcombe Bay and Schnapper Point, Victoria, all come from the early (Batesfordian) to middle (Bairnsdalian) Miocene Balcombe Clay, a unit within the Fyansford Formation which crops out along the eastern coast of Port Phillip Bay, Vic., in the region of Mornington. The two main fossil localities for this formation are Fossil Beach (the type section for the Balcombian Stage) and south of Manyung Rocks. It should be noted that at Schnapper Point the exposed sediments belong to the non-fossiliferous fluviatile Baxter Sandstone of Mitchellian to Cheltenhamian age (Gostin 1966), so it appears that the fossils described from this locality must represent material from either Fossil Beach or south of Manyung Rocks.

The species described from the Hamilton area of Victoria come from the fossil localities at MacDonalds (Bank), Clifton Bank and Forsyths (Bank). The locality at Clifton Bank occurs in the Balcombian–Bairnsdalian Muddy Creek Marl which crops out on Muddy Creek. Disconformably overlying this formation is the Kalimnan (early Pliocene) Grange Burn Formation which occurs on Muddy Creek at MacDonalds (Bank) and on Grange Burn at Forsyths (Bank) (Spencer-Jones 1971). It should be noted that Ashby's locality for Clifton Bank is incorrect, as it is situated on Muddy Creek not Grange Burn.

The species described from South Australia are from Torrensville Bore and Holden's Bore at Woodville, both in western suburbs of Adelaide. All three species come from the late Pliocene (Yatalan) Dry Creek Sands.Where possible, the original type localities have been updated.

Family ACANTHOCHITONIDAE

Genus **Acanthochites** Risso, 1826

Acanthochites (Notoplax) granulosus Ashby & Torr, 1901
Trans. R. Soc. S. Aust. **25**(2): 139, pl.4, fig. 9.
= *Protochiton granulosus* (Ashby & Torr, 1901) (PROTOCHITONIDAE).
Syntypes: T844, 1 incomplete median valve, from Schnapper Point, Mornington, Vic., Balcombe Clay, early to middle Miocene (Batesfordian – Bairnsdalian), collector and date of collection unknown.T845, 1 incomplete median valve, same collection data as T844.
Note: See note on Schnapper Point in the Stratigraphical Notes.

Acanthochites rostratus Ashby & Torr, 1901
Trans. R. Soc. S. Aust. **25** (2): 140, pl. 4, fig. 5.
= *Afossochiton rostratus* (Ashby & Torr, 1901).
Holotype: T841, 1 incomplete median valve, from Schnapper Point, Mornington, Vic., Balcombe Clay, early to middle Miocene (Batesfordian – Bairnsdalian), collected by R. Tate and J. Dennant, date of collection unknown.
Note: See note on Schnapper Point in Stratigraphical Notes. Type unique.

Genus **Acanthochiton** Gray, 1821 em. Iredale, 1915.

Acanthochiton (Eoplax) adelaidae Ashby & Cotton, 1936.
Rec. S. Aust. Mus. **5** (4): 510, fig. 2.
= *Notoplax adelaidae* (Ashby & Cotton, 1936).
Holotype: P10159 (ex D12882), 1 incomplete median valve, from 151 m depth, Torrensville Bore, Adelaide, S.A., Dry Creek Sands, late Pliocene (Yatalan), collected by W.J. Kimber, date of collection unknown.
Note: Type unique.

Acanthochiton balcombiensis Ashby, 1939
Proc. Linn. Soc. Lond. **151**(3): 188, pl. 3, fig. 4.
= *Acanthochitona balcombiensis* Ashby, 1939.
Holotype: P10160, 1 incomplete median valve, from Balcombe Bay, Mornington, Vic., Balcombe Clay, early to middle Miocene (Batesfordian–Bairnsdalian), collected by F.A. Cudmore, date of collection unknown. Note: Type unique.

Acanthochiton casus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 214, pl. 20, fig. 30.
= *Acanthochitona casa* Ashby & Cotton, 1939.
Holotype: P4349, 1 incomplete median valve, from Clifton Bank, Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian–Bairnsdalian), collected by W. Greed, date of collection unknown.
Note: Cotton and Weeding (1941) suggest this species may be a juvenile of *Afossochiton cudmorei* Ashby, 1925, which is followed by van Belle (1981). However, we believe the specimen is adult and represents a distinct species of *Acanthochitona*. Type unique.

Acanthochiton drunus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 214, pl.20, fig. 29.
= *Acanthochitona druna* Ashby & Cotton, 1939.
Holotype: P4348, 1 incomplete median valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Type unique.

Acanthochiton forsythensis Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 213, pl. 20, fig. 27.
=*Acanthochitona forsythensis* Ashby & Cotton, 1939.
Holotype: P4345, 1 incomplete median valve, from Forsyths (Bank), Grange Burn, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Paratype: P10156, 1 incomplete median valve, with same collection data as holotype.
Note: The specimen from Clifton Bank recorded by Ashby & Cotton (1939) is missing, presumed lost.

Acanthochiton (Lirachiton) inexpectus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6** (3): 215, pl. 20, fig. 31.
=*Notoplax (Bassethullia) inexpecta* (Ashby & Cotton, 1939).
Holotype: P4350, 1 complete posterior valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Generic placement follows Gowlett-Holmes (1987). Type unique.

Acanthochiton pilsbryoides Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 216, pl .20, fig. 27.
= *Acanthochitona pilsbryoides* Ashby & Cotton, 1939.
Holotype: P4346, 1 complete median valve, from Clifton Bank, Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian–Bairnsdalian), collected by W. Greed, date of collection unknown.
Note: Type unique.

Acanthochiton sabratus Ashby & Cotton, 1939
*Rec. S. Aust. Mus.***6**(3): 215, pl. 20, fig. 25.
= *Acanthochitona sabrata* Ashby & Cotton, 1939.
Holotype: P4344, 1 incomplete median valve, from Clifton Bank, Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian–Bairnsdalian), collected by W. Greed, date of collection unknown.
Note: Originally labelled and registered as *Acanthochiton parus*, later corrected to *A. sabratus*. *A. parus* may have been the original manuscript name, but was never published. Type unique.

Acanthochiton singletoni Cotton & Godfrey, 1940
'The Molluscs of South Australia Part II' p. 570, fig. 588.
= *Acanthochitona singletoni* Cotton & Godfrey, 1940.
Holotype: P4341, 1 complete median valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: This specimen was originally recorded as *Afossochiton cudmorei* Ashby, 1925 by Ashby & Cotton (1939), and incorrectly labelled 'holotype' on the plate caption. Type unique.

Acanthochiton trianguloides Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 216, pl. 20, fig. 28.
= *Acanthochitona trianguloides* Ashby & Cotton, 1939.
Holotype: P4347, 1 incomplete median valve, from Forsyths (Bank), Grange Burn, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Type unique.

Genus **Afossochiton** Ashby, 1925

Afossochiton cudmorei Ashby, 1925
Proc. R. Soc. Vic. (NS) **37**(2): 179, pl. 18, figs 6, 7.
Paratypes: P10150, 1 incomplete median valve, from Clifton Bank, Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian–Bairnsdalian), collector and date of collection unknown. T846, 1 incomplete median valve, same collection data as P10150.
Note: P10150 is registered as from Balcombe Bay, Vic. and labelled as from MacDonalds, Muddy Creek. However, as it is definitely Ashby's (1925) figured specimen 'No. 2, paratype' we regard both the register and the label as incorrect. T846 corresponds to Ashby's (1925) specimen 'No. 3, paratype'. Holotype in NMV (P13311).

Afossochiton (Telochiton) dendus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 211, pl. 20, fig. 24.
= *Afossochiton dendus* Ashby & Cotton, 1939.
Holotype: P4342, 1 incomplete anterior valve, from Clifton Bank, Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian–Bairnsdalian), collected by W. Greed, date of collection unknown.
Note: Type unique.

Afossochiton (Telochiton) iscus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 212, pl. 19, fig. 20.
= *Afossochiton iscus* Ashby & Cotton, 1939.
Holotype: P4339, 1 complete posterior valve, from Clifton Bank, Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian–Bairnsdalian), collected by W. Greed, date of collection unknown.
Note: Type unique.

Afossochiton (Telochiton) magnicostatus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 212, pl. 20, fig. 23.

= *Afossochiton magnicostatus* Ashby & Cotton, 1939.
Holotype: P4343, 1 incomplete median valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Type unique.

Afossochiton sulci Ashby & Cotton, 1939
Rec. S. Aust. Mus. 6(3): 210, pl. 20, fig. 21.
Holotype: P4340, 1 complete anterior valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Type unique.

Genus **Notoplax** H. Adams, 1861

Molachiton naxus Ashby & Cotton, 1939
= *Notoplax (Bassethullia) inexpecta* (Ashby & Cotton, 1939).
see LEPTOCHITONIDAE

Family **CHITONIDAE**

Genus **Anthochiton** Thiele, 1893

Anthochiton duodeni Ashby & Cotton, 1939
Rec. S. Aust. Mus. 6(3): 235, pl. 20, fig. 38.
= *Chiton (Rhyssoplax) duodeni* (Ashby & Cotton, 1939).
Holotype: P4357, 1 incomplete median valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Type unique.

Anthochiton macdonaldensis Ashby & Cotton, 1939
Rec. S. Aust. Mus. 6(3): 234, pl. 21, fig. 39.
= *Chiton (Rhyssoplax) macdonaldensis* (Ashby & Cotton, 1939).
Holotype: P4359, 1 complete posterior valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Type unique.

Anthochiton octocostatus Ashby & Cotton, 1939
Rec. S. Aust. Mus. 6(3): 235, pl. 21, fig. 40.
= *Chiton (Rhyssoplax) octocostatus* (Ashby & Cotton, 1939).
Holotype: P4360, 1 half median valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Type unique.

Genus **Chiton** Linnaeus, 1758

Chiton fossicus Ashby & Torr, 1901
Trans. R. Soc. S. Aust. 25(2): 140, pl. 4, fig. 4.
= *Chiton (Rhyssoplax) fossicus* Ashby & Torr, 1901.
Holotype: T840, 1 incomplete median valve, from Table Cape, Tas., Table Cape Group, early Miocene (Longfordian), collected by R. Tate and J. Dennant, date of collection unknown.
Note: Type unique.

Chiton paucipustulosus Ashby & Torr, 1901
Trans. R. Soc. S. Aust. 25(2): 141, pl. 4, fig. 2.
= *Loricella paucipustulosa* (Ashby & Torr, 1901) (SCHIZOCHITONIDAE).
Holotype: T839, 1 complete median valve, from Table Cape, Tas., Table Cape Group, early Miocene (Longfordian), collected by R. Tate and J. Dennant, date of collection unknown.
Note: A specimen of this species in the collection (P4366) is labelled 'Pleisiotype'. This specimen is Ashby and Cotton's (1939) 'Hypotype' and has no type status. Type unique.

Chiton (Anthochiton) tricostalis relata Ashby & Cotton, 1936
Rec. S. Aust. Mus. 5(4): 509, fig. 1.
= *Chiton (Rhyssoplax) tricostalis relatus* Ashby & Cotton, 1936.
Holotype: P10157 (ex D12883), 1 incomplete median valve, from 151m depth, Torrensville Bore, Adelaide, S.A., Dry Creek Sands, late Pliocene (Yatalan), collected by W.J. Kimber, date of collection unknown.
Note: Type unique.

Family **CRYPTOPLACIDAE**

Genus **Cryptoplax** Blainville, 1818

Cryptoplax ludbrookae Ashby, 1940
Trans. R. Soc. S. Aust. 64(2): 266.
Holotype: P4285; 1 complete anterior valve, from 103–117 m depth, bore at Holden's Motor Body Works, Woodville, Adelaide, S.A., Dry Creek Sands, late Pliocene (Yatalan), collected by S.A. Department of Mines, 1934.
Note: Type unique.

Cryptoplax numicus Ashby & Cotton, 1939
Rec. S. Aust. Mus. 6(3): 219, pl. 19, fig. 18.
Holotype: P4337, 1 incomplete median valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Type unique.

MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Paratypes: P12829, 1 incomplete anterior valve and 1 incomplete median valve, with same collection data as holotype.
Note: The anterior valve in lot P12829 is Ashby & Cotton's (1939) 'Hypotype'.

Family **ISCHNOCHITONIDAE**

Genus **Callistochiton** Dall, 1882

Callistochiton greedi Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 232, pl. 21, fig. 41.
Holotype: P4369, 1 half median valve, from Forsyths (Bank), Grange Burn, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Paratypes: P12823, 2 median valve fragments, with same collection data as holotype.
Note: Ashby and Cotton (1939) list 4 paratype fragments. The label of P12823 states '1 sent USA Dec 1938', so the 4th fragment is presumed lost before registration, as register only lists 2 specimens.

Callistochiton inexpectus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 233, pl.21, figs 41, 42.
Holotype: P4372, 1 incomplete median valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Paratypes: P4373, 1 complete posterior valve, with same collection data as holotype. P12818, 1 incomplete median valve and 1 incomplete posterior valve, with same collection data as holotype.
Note: P4373 is Ashby and Cotton's (1939) 'Hypotype', labelled and registered as 'Pleisiotype'. All three lots originally labelled and registered as *Callistochiton affinis*, an unpublished name, and later corrected to *C. inexpectus*.

Callistochiton reticulatus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 233, pl. 21, figs 44, 45.
Holotype: P4370, 1 incomplete median valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Paratypes: P4371, 1 incomplete median valve, from Clifton Bank, Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian – Baimsdalian), collected by W. Greed, date of collection unknown. P4381, 1 incomplete posterior valve, from Forsyths (Bank), Grange Burn, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown. P12820, 2 half median valves and 1 incomplete posterior valve, with same collection data as P4381.
Note: Ashby & Cotton (1939) list a 'Hypotype' (P4383) from the same locality as the holotype, which could not be found in the collection, however, the register lists P4383 from Forsyths. P4381 is labelled 'Pleisiotype' (='Hypotype') but the locality on the label (Forsyths) differs from the locality in the register (MacDonalds). We believe the 2 specimens were confused before registration, that the 'Hypotype' specimen of Ashby & Cotton (1939) has been lost, and replaced by P4381, which is part of the lot of 4 specimens from Forsyths mentioned by Ashby & Cotton (1939), the remainder of the lot being P12820.

Genus **Callochiton** Gray, 1847

Callochiton macdonaldi Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 227, pl. 21, fig. 46.
Holotype: P4368, 1 incomplete median valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Type unique.

Callochiton (Ocellochiton) sulci Ashby, 1939
Proc. Linn. Soc. Lond. **151**(3): 187, pl. 3, figs 1–3.
= *Ocellochiton sulci* (Ashby, 1939).
Holotype: P10158; 1 incomplete median valve, from Balcombe Bay, Mornington, Vic., Balcombe Clay, early to middle Miocene (Batesfordian–Baimsdalian), collected by F.A. Cudmore, date of collection unknown.
Paratypes: P26776, 1 incomplete anterior valve and 1 incomplete posterior valve with same collection data as holotype.

Genus **Ischnochiton** Gray, 1847

Ischnochiton (Radsiella) cliftonensis Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 231, pl. 19, fig. 14.
= *Lavenachiton cliftonensis* (Ashby & Cotton,'1939) (INCERTAE SEDIS).
Holotype: P4333, 1 incomplete median valve, from Clifton Bank, Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian–Baimsdalian), collected by W. Greed, date of collection unknown.
Note: Type unique.

Ischnochiton cossyrus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 229, pl. 20, fig. 37.
Holotype: P4356, 1 incomplete posterior valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Type unique.

Ischnochiton durius Ashby & Cotton, 1939
Rec. S. Aust. Mus. 6(3): 230, pl. 20, fig. 33.
= *Ischnochiton cossyrus* Ashby & Cotton, 1939.
Holotype: P4352, 1 incomplete posterior valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Type unique.

Ischnochiton neglectus Ashby & Cotton, 1939
Rec. S. Aust. Mus. 6(3): 231, pl. 20, fig. 34.
Holotype: P4353, 1 half median valve, from Forsyths (Bank), Grange Burn, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Paratypes: P12819, 2 fragments of median valves with same collection data as holotype.

Ischnochiton numantius Ashby & Cotton, 1939
Rec. S. Aust. Mus. 6(3): 229, pl. 19, fig. 16.
Holotype: P4335, 1 incomplete posterior valve, from Forsyths (Bank), Grange Burn, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Type unique.

Ischnochiton tisurus Ashby & Cotton, 1939
Rec. S. Aust. Mus. 6(3): 228, pl. 19, fig. 15, pl. 20, fig. 35.
= *Ischnochiton vinazus* Ashby & Cotton, 1939.
Holotype: P4334, 1 half median valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Paratypes: P12838, 1 fragment of a median valve, with same collection data as holotype. P26767, 1 half median valve, from Forsyths (Bank), Grange Burn, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: One paratype of this species, Ashby & Cotton's (1939) 'Hypotype' P4354, is now the holotype of *Ischnochiton varenae* Cotton & Godfrey, 1940.

Ischnochiton varenae Cotton & Godfrey, 1940
'The Molluscs of South Australia Part II' p. 570, fig. 579.
Holotype: P4354, 1 incomplete posterior valve, from Forsyths (Bank), Grange Burn, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: This specimen was originally a paratype of *Ischnochiton tisurus* Ashby & Cotton, 1939 [Ashby & Cotton's (1939) 'Hypotype']. Type unique.

Ischnochiton vinazus Ashby & Cotton, 1939
Rec. S. Aust. Mus. 6(3): 228, pl. 20, fig. 36.
Holotype: P4355, 1 half median valve, from Macdonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Paratypes: P12828, 2 fragments of median valves with same collection data as holotype.

Genus **Ocellochiton** Ashby, 1939

Lorica oculea Ashby & Cotton, 1939
= *Ocellochiton sulci* (Ashby, 1939).
see SCHIZOCHITONIDAE

Lorica varena Ashby & Cotton, 1939
= *Ocellochiton sulci* (Ashby, 1939).
see SCHIZOCHITONIDAE

Family **LEPTOCHITONIDAE**

Genus **Belchiton** Ashby & Cotton, 1939

Belchiton pulcherrimus Ashby & Cotton, 1939
Rec. S. Aust. Mus. 6(3): 221, pl. 19, fig. 10.
= *Leptochiton pulcherrimus* (Ashby & Cotton, 1939).
Holotype: P4329, 1 incomplete median valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Paratype: P12799, 1 incomplete median valve, with same collection data as holotype.

Genus **Lepidopleurus** Risso, 1826

Lepidopleurus babidus Ashby & Cotton, 1939
Rec. S. Aust. Mus. 6(3): 226, pl. 19, fig. 6.
= *Leptochiton babidus* (Ashby & Cotton, 1939).
Holotype: P4325, 1 half median valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Paratype: P12821, 2 median valve fragments, with same collection data as holotype.

Lepidopleurus badioides Ashby & Cotton, 1939
Rec. S. Aust. Mus. 6(3): 222, pl. 19, fig. 4, pl. 21, fig. 47.
= *Leptochiton badioides* (Ashby & Cotton, 1939).
Holotype: P4323, 1 incomplete posterior valve, from Clifton Bank, Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian – Bairnsdalian), collected by W. Greed, date of collection unknown.
Paratypes: P4358, 2 fragments of a median valve, from Forsyths (Bank), Grange Burn, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown. P12804, 2 fragments of a posterior valve, with same collection data as P4358. P12805, 1 incomplete

median valve, with same collection data as P4358.

Lepidopleurus clifdenensis Ashby, 1929
Trans. N. Z. Inst. **60**: 367, pl. 32, figs 8a, 8b.
= *Leptochiton clifdenensis* (Ashby, 1929).
Holotype: P10162, 1 fragment of a median valve, from Clifden, South Island, N.Z., Clifden Limestone, early Miocene (Hutchinsonian), collector and date of collection unknown.
Note: Type unique. Ashby (1929b) lists two fragments of the holotype, the second fragment is missing, presumed lost.

Lepidopleurus diversigranosus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 227, pl. 19, figs 1, 9.
= *Leptochiton diversigranosus* (Ashby & Cotton, 1939).
Holotype: P4328, 1 incomplete posterior valve, from Clifton Bank, Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian–Bairnsdalian), collected by W. Greed, date of collection unknown.
Paratype: P4320, 1 incomplete median valve, with same collection data as holotype. Note: The paratype P4320 is Ashby & Cotton's (1939) 'Hypotype'.

Lepidopleurus magnogranifer Ashby, 1925
Proc. R. Soc. Vic. (NS) **37**(2): 171, pl. 18, fig. 1.
= *Leptochiton magnogranifer* (Ashby, 1925).
Holotype: T847, 1 incomplete median valve, from Muddy Creek, Hamilton, Vic., exact stratum not recorded, collected by J. Dennant and R. Tate, date of collection unknown.
Note: A label with the holotype lists the locality as Clifton Bank, (Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian–Bairnsdalian), which is the type locality defined by Ashby and Cotton (1939) with their 'Pleisiotype' (P4322), which is not a valid type.Type unique.

Lepidopleurus nivarus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 222, pl. 19, fig. 5.
= *Leptochiton nivarus* (Ashby & Cotton, 1939).
Holotype: P4324, 1 incomplete median valve, from Clifton Bank, Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian – Bairnsdalian), collected by W. Greed, date of collection unknown.
Paratypes: P26744, 2 fragments of median valves, with same collection data as holotype.

Lepidopleurus pamphilius Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 222, pl. 19, fig. 2.
= *Protochiton granulosus* (Ashby & Torr, 1901) (PROTOCHITONIDAE)
Holotype: P4321, 2 fragments of a median valve, from Clifton Bank, Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian – Bairnsdalian), collected by W. Greed, date of collection unknown.
Note: Type unique.

Lepidopleurus relatus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 224, pl. 19, fig. 12.
= *Leptochiton magnogranifer* (Ashby, 1925).
Holotype: P4331, 2 fragments of a median valve, from Clifton Bank, Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian–Bairnsdalian), collected by W. Greed, date of collection unknown.
Paratypes: P12807, 1 median valve fragment, with same collection data as holotype. P12808, 1 median valve fragment, with same collection data as holotype.
Note: After examining both types, we agree with Cotton & Weeding (1941) and van Belle (1981) in synonymising this species with *L. magnogranifer* (Ashby, 1925). However, the types of the latter are much more worn than the types of *L. relatus*, not the reverse, as was stated by Cotton & Weeding (1941). The holotype was broken into two pieces subsequent to its description.

Lepidopleurus sephus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 225, pl. 19, fig. 11.
= *Leptochiton sephus* (Ashby & Cotton, 1939).
Holotype: P4330, 1 incomplete median valve, from Forsyths (Bank), Grange Burn, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Type unique.

Lepidopleurus sinervus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 225, pl. 19, fig. 7.
= *Leptochiton sinervus* (Ashby & Cotton, 1939).
Holotype: P4326, 1 fragment of an anterior valve, from Forsyths (Bank), Grange Burn, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Paratype: P26743, 2 fragments of an anterior valve, with same collection data as holotype.

Lepidopleurus singus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 226, pl. 19, fig. 8.
= *Leptochiton singus* (Ashby & Cotton, 1939).
Holotype: P4327, 1 complete posterior valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W.Greed, date of collection unknown.
Note: Type unique.

? Lepidopleurus uxellus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 223, pl.19, fig.13.
= *Leptochiton uxellus* (Ashby & Cotton, 1939).
Holotype: P4332, 1 incomplete posterior valve, from

Forsyths (Bank), Grange Burn, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Type unique.

Genus **Molachiton** Ashby & Cotton, 1939

Molachiton naxus Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 220, pl. 20, fig. 32.
= *Notoplax (Bassethullia) inexpecta* (Ashby & Cotton, 1939) (ACANTHOCHITONIDAE)
Holotype: P4351, 1 half median valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Generic placement follows Gowlett-Holmes (1987). Type unique.

Family **MOPALIIDAE**

Genus **Plaxiphora** Gray, 1847

Plaxiphora concentrica Ashby & Torr, 1901
Trans. R. Soc. S. Aust. **25**(2): 138, pl. 4, fig. 8.
= *Plaxiphora (P.) albida* (Blainville, 1825) (Recent species).
Holotype: T836, 1 complete posterior valve, from Gellibrand River, Vic., early Miocene, collector and date of collection unknown.
Note: We believe that this valve is from a recent specimen, and that the age and stratum are incorrect. We therefore regard it as a synonym of *P. (P.) albida*, an extant species. Type unique.

Plaxiphora gellibrandi Ashby & Torr, 1901
Trans. R. Soc. S. Aust. **25**(2): 139, pl. 4, fig. 1.
= *Plaxiphora (P.) albida* (Blainville, 1825) (Recent species).
Holotype: T837, 1 complete posterior valve, from Gellibrand, Vic., early Miocene, collector and date of collection unknown.
Note: The age and stratum are apparently in error as the valve is from a recent specimen. Type unique.

Family **PROTOCHITONIDAE**

Genus **Protochiton** Ashby, 1925

Acanthochites (Notoplax) granulosus Ashby & Torr, 1901
= *Protochiton granulosus* (Ashby & Torr, 1901).
see ACANTHOCHITONIDAE

Lepidopleurus pamphilius Ashby & Cotton, 1939
= *Protochiton granulosus* (Ashby & Torr, 1901).
see LEPTOCHITONIDAE

Family **SCHIZOCHITONIDAE**

Genus **Aulacochiton** Shuttleworth, 1853

Aulacochiton erma Cotton & Godfrey, 1940
'The Molluscs of South Australia Part II' p. 570, fig. 588.
= *Lorica compressa* Ashby & Torr, 1901.
Holotype: P4286, 1 incomplete median valve, from Clifton Bank, Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian–Bairnsdalian), collector and date of collection unknown.
Note: Van Belle (1981) considers *A. erma* to be a distinct species, but after comparing the holotypes of this species and *Lorica compressa*, we believe they are conspecific, and that the holotype of *A. erma* is a very weathered example of *L. compressa*. Type unique.

Genus **Lorica** H. & A. Adams, 1852

Lorica affinis Ashby & Torr, 1901
Trans. R. Soc. S. Aust. **25**(2): 137, pl. 4, fig. 7.
= *Lorica compressa* Ashby & Torr, 1901.
Holotype: T843, 1 incomplete median valve, from Table Cape, Tas., Table Cape Group, early Miocene (Longfordian), collected by R. Tate and J. Dennant, date of collection unknown.
Note: The locality and age were not given by Ashby & Torr (1901), but the type is clearly labelled 'Table Cape', which is the locality given for this species by Ashby (1925). Type unique.

Lorica compressa Ashby & Torr, 1901
Trans. R. Soc. S. Aust. **25**(2): 136, pl. 4, fig. 6.
Holotype: T842, 1 incomplete median valve, from Table Cape, Tas., Table Cape Group, early Miocene (Longfordian), collected by R. Tate and J. Dennant, date of collection unknown.
Note: The locality and age were not given by Ashby & Torr (1901), but the type is clearly labelled 'Table Cape', which is the locality given for this species by Ashby (1925). Type unique.

Lorica oculea Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 237, pl. 21, fig. 48.
= *Ocellochiton sulci* (Ashby, 1939) (ISCHNOCHITONIDAE).
Holotype: P4362, 1 incomplete median valve, from Clifton Bank, Muddy Creek, Hamilton, Vic:, Muddy Creek Marl, early to middle Miocene (Balcombian–Bairnsdalian), collected by W. Greed, date of collection unknown.
Paratype: P12817, 1 incomplete median valve with same collection data as holotype.

Lorica varena Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 238, pl. 21, fig. 49.

= *Ocellochiton sulci* (Ashby, 1939) (ISCHNOCHITONIDAE).
Holotype: P4361, 1 incomplete median valve, from Clifton Bank, Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian–Bairnsdalian), collected by W. Greed, date of collection unknown.
Note: Type unique.

Genus **Loricella** Pilsbry, 1893

Loricella concava Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 236, pl. 21, fig. 51.
Holotype: P4367, 1 incomplete posterior valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Note: Type unique.

Loricella gigantea Ashby & Torr, 1901
Trans. R. Soc. S. Aust. **25**(2): 137, pl. 4, fig. 3.
Holotype: T838, 1 incomplete anterior valve, from Schnapper Point, Mornington, Vic., Balcombe Clay, early to middle Miocene (Batesfordian–Bairnsdalian), collected by R. Tate and J. Dennant, date of collection unknown.
Note: Ashby (1925) states the above locality is in error for the Freestone Cove Sandstone ('Lower Beds'), Table Cape, Tas., early Miocene (Longfordian). See note on Schnapper Point in Stratigraphical Notes. Type unique.

Loricella magnopustulosa Ashby & Cotton, 1939
Rec. S. Aust. Mus. **6**(3): 235, pl. 21, figs 50, 53.
Holotype: P4365, 1 incomplete anterior valve, from MacDonalds (Bank), Muddy Creek, Hamilton, Vic., Grange Burn Formation, early Pliocene (Kalimnan), collected by W. Greed, date of collection unknown.
Paratype: P4364, 1 half median valve, same collection data as holotype.
Note: P4364 is Ashby & Cotton's (1939) 'Hypotype'. The two paratypes listed by Ashby & Cotton (1939) are missing, presumed lost.

Chiton paucipustulosa Ashby & Torr, 1901
= *Loricella paucipustulosa* (Ashby & Torr, 1901).
see CHITONIDAE

Genus **Oochiton** Ashby, 1929

Oochiton halli Ashby, 1929
Proc. R. Soc. Vic. (NS) **41**(2): 222, pl. 24, figs 1a, b, 2, 3a-c, 8a, b.
Neotype: P4393, 1 complete anterior valve, from Clifton Bank, Muddy Creek, Hamilton, Vic., Muddy Creek Marl, early to middle Miocene (Balcombian–Bairnsdalian), collected by W. Greed, date of collection unknown.
Note: Neotype selected by Ashby & Cotton (1939) to replace type destroyed by fire in Ashby's house on March 9, 1934. This specimen was selected to replace 'holotype of the head valve of this species' according to Ashby & Cotton (1939), however the holotype was a median valve according to Ashby (1929a). As none of the types listed by Ashby (1929a) could be found, we believe that they were all destroyed by fire, and that the anterior valve listed above is a valid neotype.

INCERTAE SEDIS

Genus **Lavenachiton** Cotton & Godfrey, 1940

Ischnochiton (Radsiella) cliftonensis Ashby & Cotton, 1939
= *Lavenachiton cliftonensis* (Ashby & Cotton, 1939).
see ISCHNOCHITONIDAE

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ON AUSTRALIAN HERSILIIDAE FROM THE SOUTH AUSTRALIAN MUSEUM (ARACHNIDA: ARANEAE) SUPPLEMENT TO THE REVISION OF THE AUSTRALIAN HERSILIIDAE

B. BAEHR & M. BAEHR

BAEHR, B. & BAEHR, M. 1988. On Australian Hersiliidae from the South Australian Museum (Arachnida: Araneae). Supplement to the revision of the Australian Hersiliidae. *Rec. S. Aust. Mus.* 22 (1): 13–20.

A collection of hersiliid spiders from the South Australian Museum is examined. *Tamopsis forresti* sp. nov. from north-western Queensland and *T. ediacarae* sp. nov. from central south Australia are newly described. New records are given for *T. eucalypti* (Rainbow), *T. queenslandica* Baehr & Baehr, *T. raveni* Baehr & Baehr, and *T. fickerti* (L. Koch), mainly from South Australia and central Australia, and the ranges of some species are considerably extended.

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The collection of Hersiliidae from the South Australian Museum, Adelaide (SAMA), comprises about 25 specimens from Queensland, South Australia and Western Australia. Because two new species and several new records, mainly from central Australia, are involved, it is worth noting in a separate paper, regarded as a supplement to our recent revision of the Australian Hersiliidae (Baehr & Baehr 1987). This supplement is evidence of the little known fauna of more remote regions of Australia, especially in inland areas. Measurements were taken as indicated previously (Baehr & Baehr 1987).

Abbreviations

ALE – anterior lateral eye
AME – anterior median eye
bS – basal segment of posterior lateral spinneret
LB – total length of body
LL – total length of 1st leg
PLE –posterior lateral eye
PLS – posterior lateral spinneret
PME – posterior median eye
tS – terminal segment of posterior lateral spinneret
I – 1st leg
II – 2nd leg
III – 3rd leg
IV – 4th leg

Classification

In our revision of the Australian Hersiliidae all known species were transferred from *Chalinura* or *Tama*, respectively, to a new genus *Tamopsis*. All newly described species, with exception of the singular *Hersilia australiensis* Baehr & Baehr, also belong to *Tamopsis*. As the collection from the SAMA comprises only species of *Tamopsis*, apart from a single juvenile *Hersilia* specimen (N11979100) which we are unable to determine, no generic diagnosis needs to be included.

Tamopsis eucalypti (Rainbow)

Tama eucalypti Rainbow, 1900: 487

This species is widely distributed in south-eastern Australia from south-east Queensland through eastern New South Wales, Victoria to Eyre Peninsula in South Australia. Specimens from SAMA are identified by the conspicuous shape of the female vulva.

New records

South Australia: 2 females (N 1987181), Belair NP, Mt Lofty Ranges, i. 1936, Coll. H. Womersley; 1 female (N1987182), Fullarton, Adelaide, x. 1935, Coll. H. Womersley; 5 females (N 1987183), Adelaide, 1936, Coll. H. Womersley.

Tamopsis cf. *queenslandica* Baehr & Baehr (Fig. 4)

Baehr & Baehr, 1987: 372

This species was newly described from a male and female from southern Queensland and from New South Wales, respectively. It belongs to a group of several closely related species characterized by the depressed eye area and rather similar male palpi and female vulvae (see Baehr & Baehr 1987).

The single specimen from the SAMA is doubtfully assigned to *T. queenslandica* by virtue of the shape of its female vulva. This assignment, however, is somewhat hypothetical, because the specimen was apparently dried out and, as a consequence, is rather damaged. Hence the vulva is difficult to examine. If our determination is right, this would mean a considerable expansion of the range of this species right through

central Australia to the Northern Territory–Western Australian border. It is worth noting in this connexion that both original records of *T. queenslandica* are from west of the Great Dividing Range. Perhaps this is an inland species.

New record

Western Australia: 1 female (N 1987184), Gill Pinnacle, Schwerin Mural Crescent, 24°54'S, 128°46'E, xi. 1963, Coll. P. Aitken & N.B. Tindale.

Tamopsis raveni Baehr & Baehr
(Fig. 4)

Baehr & Baehr, 1987: 373

Another species of the *queenslandica* group and extremely closely related to *T. queenslandica*. *T. raveni* was previously known only from a single locality in south-east Queensland. The single female specimen from the SAMA is assigned to this species mainly by the shape of its vulva.

New record

South Australia: 1 female (N 1987185), Oaktrees, Brown Hill Creek Reserve, Adelaide foothills, i. 1965, Coll. C. Luscombe. This record extends considerably the range of *T. raveni* to the south-west.

Tamopsis forresti sp. nov.
(Figs 1, 2, 4)

Types

Holotype: male (N 1987186), N.W. Queensland, 1.5 km W. by N. of Riversleigh Homestead, collected by beating bushes on dry area above Gregory River, 30. iv. 1986, Coll. J. A. Forrest. Paratype: 1 female (N 1987187), same data.

Diagnosis

Medium sized species with high eye area, large AME and moderately elongate legs, recognized by male palpus with a large, spoon-shaped, hooked process and a small lateral process on median apophysis and with three elongate lateral processes at apex of lateral apophysis, and by unique shape of female vulva.

Description of holotype (male)

Measurements: Body length: 3.48 mm. Cephalothorax length: 1.48 mm; width: 1.40 mm. Abdomen length: 2 mm; width: 1.65 mm. Legs: I: 10.04 mm, II: 9.28 mm, III: 3.72 mm, IV: 9.08 mm. Ratio: 1: 0.92: 0.37: 0.90. Ratio LB/LL: 0.35. PLS length: 1.84 mm; bS: 0.48 mm; tS: 1.36 mm. Eye ratio: 1: 0.33:0.78: 0.67.

Colour: Cephalothorax light brown, eye area, border, several radial spots, and dorsal groove piceous to blackish. Clypeus dirty white, with two dark spots. Chelicerae greyish to brown. Abdomen mottled, with distinct lancet-shaped median stripe and lateral borders dark; posteriorly with some transverse light and dark bands. Ventral surface light. Legs light, conspicuously annulate, femora anteriorly–ventrally striped with black.

Cephalothorax: Circular, slightly narrower than abdomen. Eye area considerably raised, clypeus slightly higher than eye area. AME by far largest, PLE slightly smaller than PME. Distance AME/AME slightly less than diameter of AME, distance AME/ALE about equal to diameter of AME. Distance PME/PME about half of diameter of PME, distance PME/PLE about equal to diameter of PLE. Chelicerae about $1\,^{3}/_{4}$ x as long as wide, posteriorly with 3 minute teeth. Sternum setose.

Abdomen: Elongate oval. Dorsally with 5 pairs of rather circular muscular pits. Ventral muscular pits in a v-shaped arrangement. PLS slightly shorter than abdomen.

Legs: Measurements see above. Moderately elongate, III slightly longer than 1/3 of I.

Palpus: Median apophysis strongly contorted, apex with wide, membraneous area within, terminally with a large, spoon-shaped process, and laterally with a shorter, curved process which is conspicuously napped outside. Lateral apophysis also contorted, apex deeply excised, laterally of excision bearing three elongate, slender, finger-like, hook-shaped structures. Inner finger apically curved away from palpus.

Description of paratype (female)

Measurements: Body length: 3.60 mm. Cephalothorax length: 1.44 mm; width: 1.40 mm. Abdomen length: 2.16 mm; width: 2.28 mm. Legs: I: 8.16 mm, II: 7.72 mm, III: 3.04 mm, IV: 7.44 mm. Ratio: 1: 0.95: 0.37: 0.91. Ratio LB/LL: 0.44. PLS length: 1.92 mm; bS: 0.48 mm; tS: 1.36 mm. Eye ratio: 1: 0.5: 0.88: 0.88.

Colour: Very similar to male holotype. Abdomen still more mottled, legs more contrastingly coloured.

Cephalothorax: Similar to male, but much narrower than abdomen. Clypeus slightly higher. Eyes smaller, especially AME smaller in relation to ALE, ALE nearly half as large as AME. PME and PLE of about equal size.

Abdomen: Slightly wider than long, rather triangular. Arrangement of dorsal and ventral muscular pits as in male. PLS slightly longer in relation to abdomen than in male.

Legs: Measurements see above. Moderately elongate, II about as long as in male.

Epigyne: Laterally with a large opening covered by a plate. Parts of vulva low, widely separated.

Vulva: With two receptacula seminis, though inner receptaculum characteristically bent and prolonged ventrally, apex slightly recurved. Only outer recep-

taculum glandular beneath capsule. Introductory duct bent, v-shaped, posteriorly produced.

Distribution

Thus far known from north-western Queensland close to Northern Territory border.

Habits

Not exactly known. Caught by beating bushes near river. Collected in April.

Relationships

This species is certainly closely related to *T. trionyx* Baehr & Baehr from southern Queensland. The male palpi of both species are fairly similar and they are recognized by their long, finger-like processes at the apex of the lateral apophysis. The palpus of *T. forresti*, however, differs in that the inner process of the lateral apophysis is curved outside rather than inwards, and that the median apophysis possesses a strong lateral process. As the female of *T. trionyx* is as yet unknown, nothing can be said on differences of female epigyne and vulva. The epigyne of *T. forresti*, however, is outstanding within the *tropica* group to the form of the inner receptaculum seminis.

Identification

For identification the key to species in our revision (Baehr & Baehr 1987) should be altered as following:

Couplet 16 – cancel 'Southern central Queensland ..... *trionyx* sp. nov.'

then add

'16 a. Lateral border of MA not modified to a spoon-like process, inner finger of LA curved inwards. Southern central Queensland. ... *trionyx* Baehr & Baehr

– Lateral border of MA modified to a spoon-like process, napped outside, inner finger of LA curved outwards. North-western Queensland .... *forresti* sp. nov.'

Couplet 37 – alter to

'– Smaller species with wider body, less than 4.5 mm long. Legs and PLS rather stout. Lateral RS directed horizontally or posteriorly. Bridge of V not a narrow clasp ..... 37 a.'

then add

'37 a. Lateral RS very small, directed horizontally. ID not strongly v-shaped. North-western Queensland .....*leichardtiana* Baehr & Baehr

– Lateral RS large, elongate, directed posteriorly, apex conspicuously incurved. ID strongly v-shaped. North-western Queensland .....*forresti* sp. nov.'

Tamopsis ediacarae sp. nov.
(Figs 3, 4)

Holotype

Female (N 1987188), South Australia, Ediacara (W. of Leigh Creek), 15. v. 1961.

Diagnosis (male unknown)

Medium-sized species with high eye area, large AME, and rather elongate legs, characterized by vulva with two equal receptacula seminis on each side, strongly coiled basal parts of introductory ducts, and anteriorly a wide bar.

Description

Measurements: Body length: 4.64 mm. Cephalothorax length: 1.88 mm; width: 1.88 mm. Abdomen length: 2.76 mm; width: 2.62 mm. Legs: I: 14.08 mm, II: 13.40 mm, III: 4.60 mm, IV: 12.48 mm. Ratio: 1: 0.95: 0.33: 0.89. Ratio LB/LL: 0.33. PLS length: 2.48 mm; bS 0.68 m; tS: 1.80 mm. Eye ratio: 1: 0.4: 0.8: 0.9.

Colour: Light-coloured. Cephalothorax medially whitish, laterally dark yellow. Eye area, lateral borders, and some radial spots blackish. Clypeus and chelicerae wholly yellow. Abdomen rather light, slightly mottled, with lancet-shaped median stripe and lateral borders fading brown. Legs and palpi very light, inconspicuously annulate. PLS laterally near base and apically in last third with distinct dark spots.

Cephalothorax: Circular, as long as wide. Eye area strongly raised, clypeus slightly higher than eye area. Eyes rather small, AME largest, PME slightly smaller than PLE. Distance AME/AME slightly less than diameter of AME. Distance PME/PME more than half of diameter of PME, distance PME/PLE about equal to diameter of PLE. Chelicerae rather elongate, about $1^3/_4$x as long as wide. Sternum heart-shaped, setose.

Abdomen: Rather wide, almost as wide as long, slightly trapezoidal, much wider than cephalothorax. Dorsally with 5 pairs of circular muscular pits. Ventral muscular pits in a slightly v-shaped arrangement. PLS rather short, considerably shorter than abdomen.

Legs: Measurement see above. Elongate, III c. 1/3 as long as I.

Epigyne: Laterally with an opening covered by a plate. Parts of vulva widely separated, anteriorly with a wide, sclerotized bridge.

Vulva: Wide, with two receptacula seminis and a basal bulbus on each side. Receptacula glandular in basal half. Introductory duct basally strongly coiled and produced outwards.

Distribution

Lake Eyre Basin, central eastern South Australia.

Habits

Unknown, type collected in May.

Relationships

T. ediacarae belongs to the large *tropica* group. Judging from the shape of the female epigyne and vulva and from relative length of legs and PLS, *T. ediacarae* is certainly most closely related to *T. pseudocircumvidens* Baehr & Baehr from south-west-

ern Australia which has a fairly similar vulva. However, the following differences are to be noted: lack of conspicuous median black stripe on clypeus in *T. ediacarae*, slightly different ratio of eye size, greater relative length of PLS, transverse bar of vulva located far anteriorly instead of medially, and introductory duct strongly coiled at base.

Since both species are known only from the female holotypes, it is at present impossible to decide whether they are actually species or just strongly varying specimens of common species with very wide range. From our experience, however, distribution of the same hersiliid species across the Nullarbor Plain is rather unlikely.

Identification

For identification the key to species in the revision (Baehr & Baehr 1987) should be altered as following:

Couple 36 – cancel

'South-western Australia..... ..... *pseudocircumvidens* Baehr & Baehr'

then add

'36 a. Bridge located rather posteriorly between RS. ID basally not coiled (Fig 34). South-western Australia ..... *pseudocircumvidens* Baehr & Baehr

–Bridge located rather anteriorly at apex of RS. ID basally strongly coiled. Eastern central South Australia ..... *ediacarae* sp. nov.'

Tamopsis fickerti (L. Koch)
(Fig. 5)

Chalinura fickerti L. Koch, 1876: 830

This is a widely distributed species in eastern Australia, though not yet reliably recorded either from Victoria or South Australia. Females of this species are at first glance recognized by their heart-shaped median plate in the epigyne.

New records

South Australia: 1 female (N 1987189), Renmark, 27.iv.1981, Coll. R.V. Southcott; 1 male (N 1987190), Mitcham, Adelaide, 14. xi. 1986, Coll. R. V. Southcott; 1 male (N 1987191), Bellevue Heights, Adelaide, 5. xii.1979, Coll. A. Bowie; 5 females, 1 juv. (N 1987192), Belair N.P., Mt Lofty Ranges, i.1936, Coll. H. Womersley; 2 females (N 1987193), Belair N.P., 16.ii.1936, Coll. H. Womersley.

Habits

For habits of this species see Baehr & Baehr (1987). Several label notes of the SAMA specimens give evidence of a rather common occurrence of *T. fickerti* on walls and houses. In the wild, however, this is a true tree-inhabiting species, living on the bark of diverse eucalypts.

T. fickerti seems to be rather common in the environs of Adelaide and is perhaps distributed over the whole of south-eastern Australia from south-eastern Queensland to at least Adelaide in South Australia.

Discussion

As demonstrated by the present work, the Australian Hersiliidae fauna is not yet adequately known. Certainly still more species are likely to be discovered and the range of most species is far from being exactly known, because several species are only known from single specimens or from a single locality. This is certainly due to the inadequate exploration of vast areas, especially in central, western, and north-western Australia, and also to the difficulties of collecting such extremely well-camouflaged spiders as Hersiliidae which commonly sit motionless in small hollows on the bark of trees or attached on branches.

The following comments stress or slightly alter those in our revision (Baehr & Baehr 1987):

1. Northern Queensland is one of the regions possessing the most diverse hersiliid fauna. Most species, however, are rather unspecialized. Although the newly described *T. forresti* of north Queensland belongs to a derivative species group, within this group it is also rather unspecialized.

2. Some species are far more widely distributed than hitherto realized. This applies mainly to species occurring in well-wooded eastern, south-eastern, and southern Australia, where tree-dwelling species are able to spread more easily over wide ranges.

3. No species were previously known from central Australia and very few from South Australia, but both faunas are more diverse than supposed.

Acknowledgments

We are indebted to Dr David C. Lee (Adelaide) for the loan of the specimens from the SAMA.

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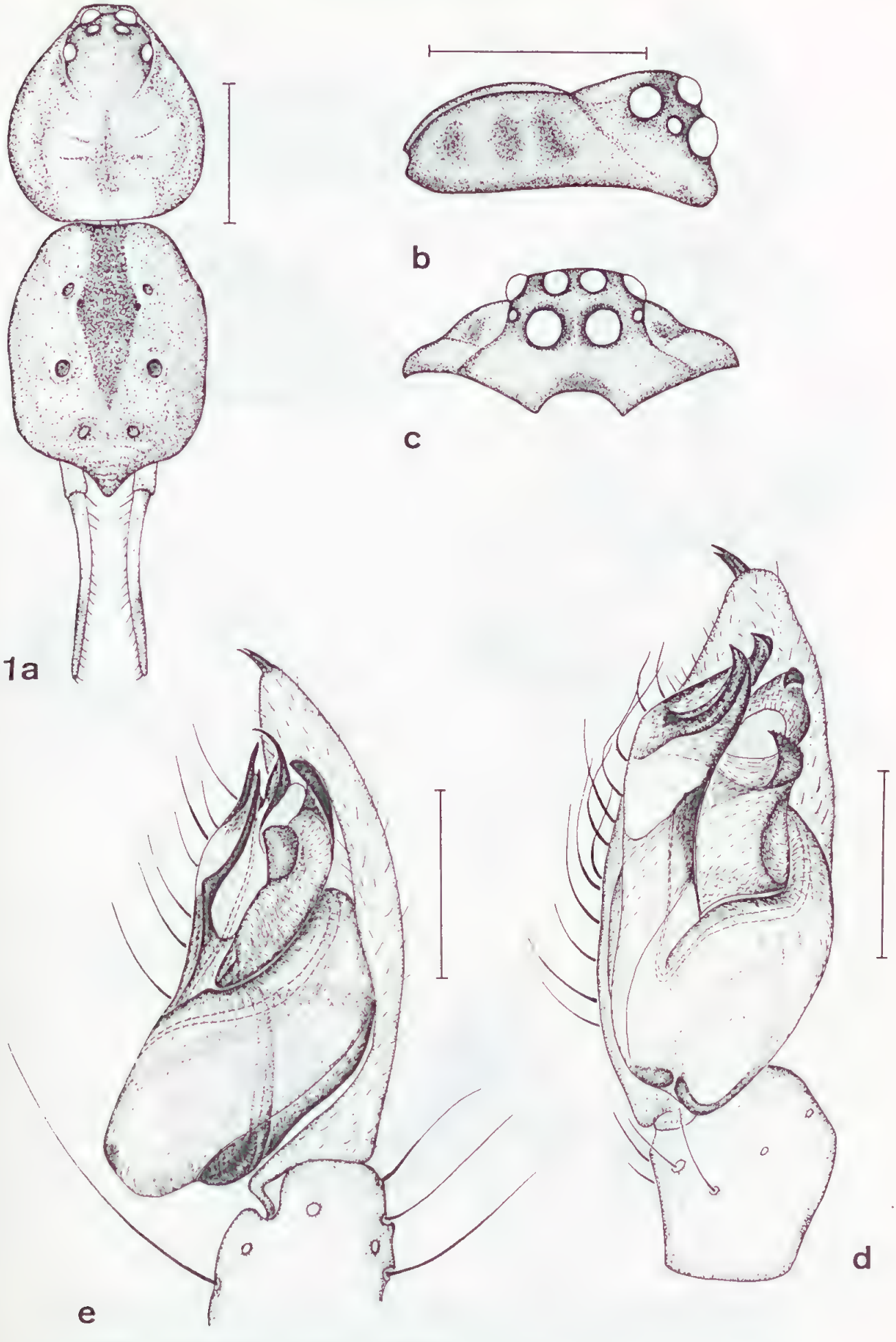


FIGURE 1. *Tamopsis forresti* sp. nov., male holotype. a. Body shape; b. Lateral view of head; c. Frontal view of head; d. Ventral view of palpus; e. Lateral view of palpus. Scales: a, b, c: 1 mm, d, e: 0.25 mm.

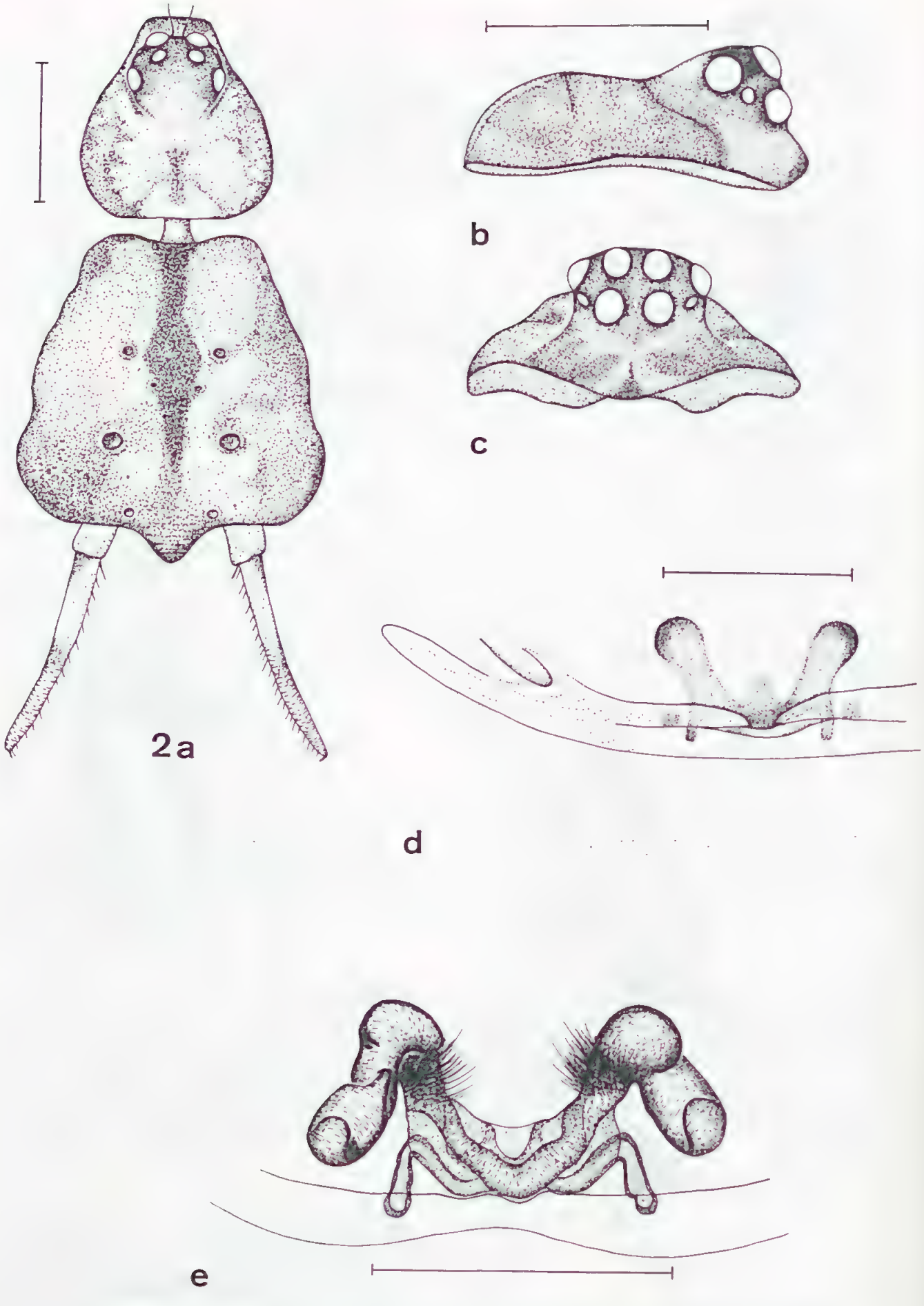
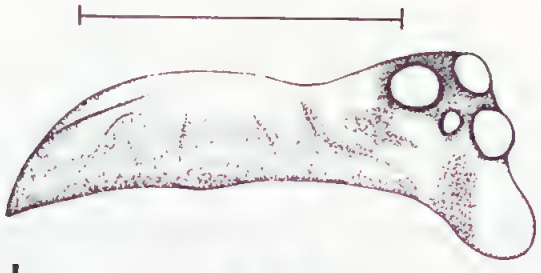
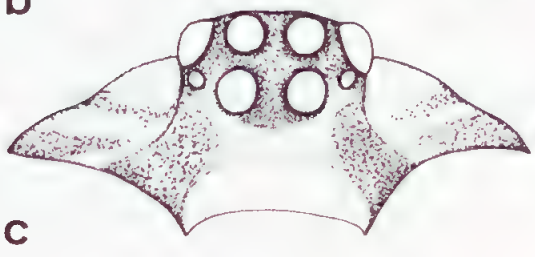
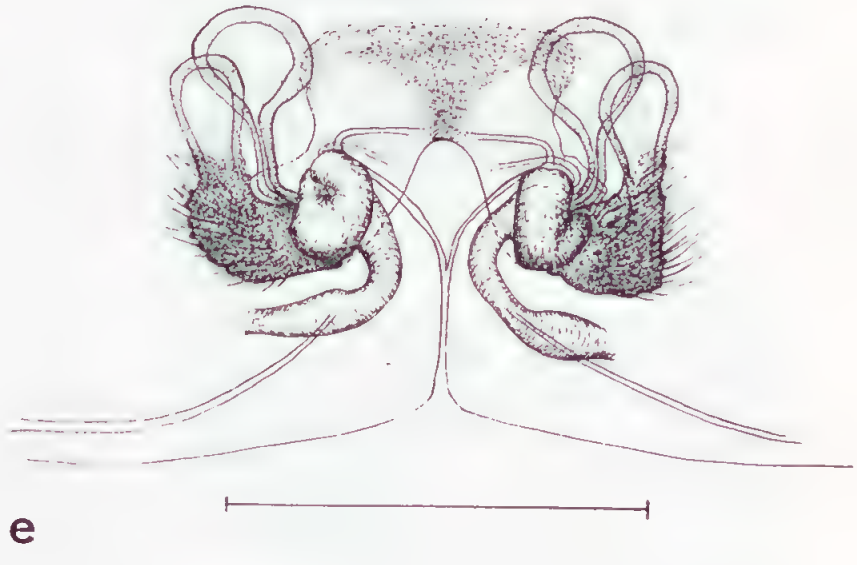


FIGURE 2. *Tamopsis forresti* sp. nov., female paratype. a. Body shape; d. Lateral view of head; c. Frontal view of head, d. Epigyne; e. Vulva. Scales: a, b, c: 1 mm, d, e: 0.25 mm.







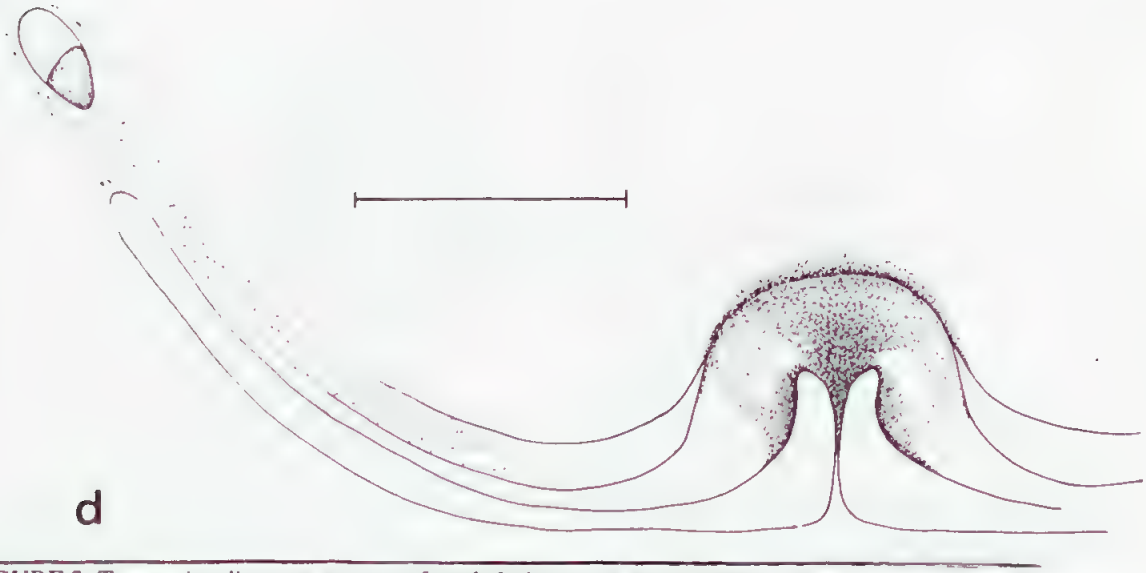


FIGURE 3. *Tamopsis ediacarae* sp. nov., female holotype. a. Body shape; b. Lateral view of head; c. Frontal view of head; d. Epigyne; e. Vulva. Scales as in Figure 2.

FIGURE 4. Distribution of *Tamopsis queenslandica* Baehr & Baehr: ■, *T. raveni* Baehr & Baehr: ▲, *T. forresti* sp. nov.: ●, and *T. ediacarae* sp. nov.: ♦.

FIGURE 5. Distribution of *Tamopsis fickerti* (L. Koch), revised map.

C. H. S. WATTS

WATTS. C. H. S. WATTS 1988. Revision of Australian Halipilidae (Coleoptera). *Rec. S. Aust. Mus.* **22** (1): 21–28.

The Australian halipilids are revised. All belong to the genus *Haliplus*. Eight species are recognised, four of which are new: *H. alastairi* sp. nov, *H. nicholasi* sp. nov, *H. stepheni* sp. nov. and *H. sindus* sp. nov. The synonymy of *H. australis* Clark with *H. testudo* Clark 1985 is confirmed. A key to species is provided and relationships between species briefly discussed

C.H.S. Watts, South Australian Museum, North Terrace, Adelaide, South Australia 5000. Manuscript received 17 June 1987.

The Australian Halipilid fauna is small with only eight known species. All belong to the worldwide genus *Haliplus*. Halipilids can be recognised from all other Australian aquatic Coleoptera by the large post-coxal plates which cover the bases of the hind legs. They are found among aquatic vegetation in still water around the coast from Adelaide eastward to Darwin. In addition, two species occur in the south-west of Western Australia and one in Tasmania. No specimens are known from the north-west. Both adult and larval stages are aquatic. No larvae of Australian species have been described. They are rare in collections and although I think this is to some degree a reflection of collecting pressure it is clear that they are not abundant. Structurally, Australian *Haliplus* fall into two clear groups. One, consisting of *H. fuscatus*, *H. gibbus* and *H. bistriatus*, is characterised by relatively small size, grooved pronotal process, well marked pronotal plicae with a depressed area between them, interstrial punctures absent or subobsolete, and a relatively narrow head. The other group, *H. testudo*, *H. alastairi*, *H. stepheni*, *H. nicholasi* and *H. sindus*, have a flat pronotal process, no pronotal plicae, no depressed area at back of pronotum and have a moderate number of punctures in most interstriae. The only major taxonomic work on Australian halipilids is that of Clark (1862) who described four species from south-eastern Australia. Regimbart described two New Guinean species in 1899 and Wehncke described *H. bistriatus* from Adelaide in 1880. The collections from which specimens were examined are listed under the following abbreviations:

AM	Australian Museum, Sydney
ANIC	Australian National Insect Collection
BMNH	British Museum (Natural History), London
CW	Private Collection of Author
MCZ	Museum of Comparative Zoology, Harvard
EUQ	Entomology Department, University of Queensland.
NMV	National Musuem of Victoria
NTM	Northern Territory Museum
SAMA	South Australian Museum
QM	Queensland Museum
QPI	Queensland Department of Primary Industry, Mareeba

Systematics

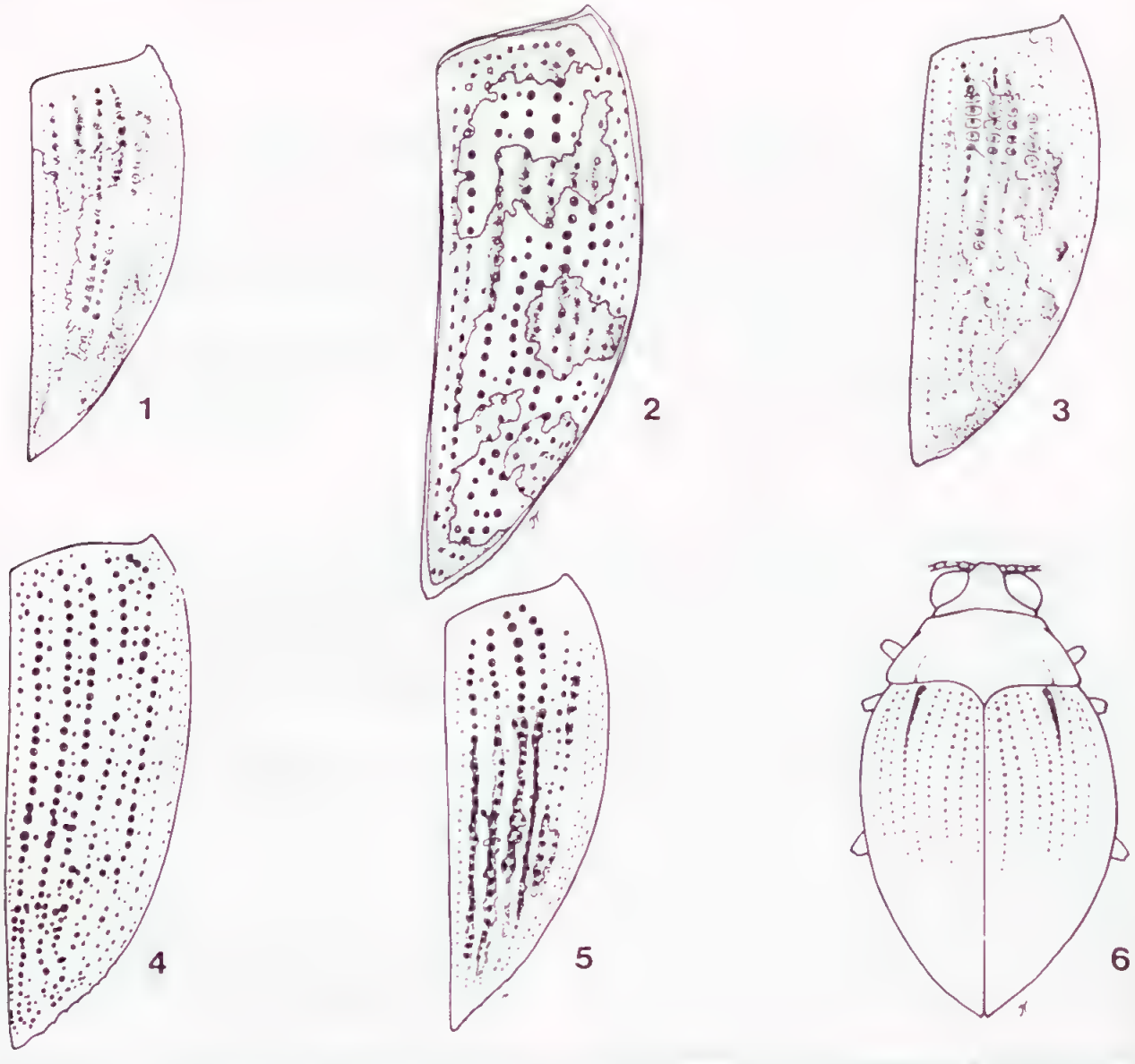
Key to Australian *Haliplus*

1. Pronotum with short to moderate plicae (Fig. 6), area between plicae depressed; pronotal process grooved; interstrial punctures lacking or subobsolete 6
   Pronotum lacking plicae, hind portion not depressed; pronotal process flat; interstrial punctures sparse but well marked 2

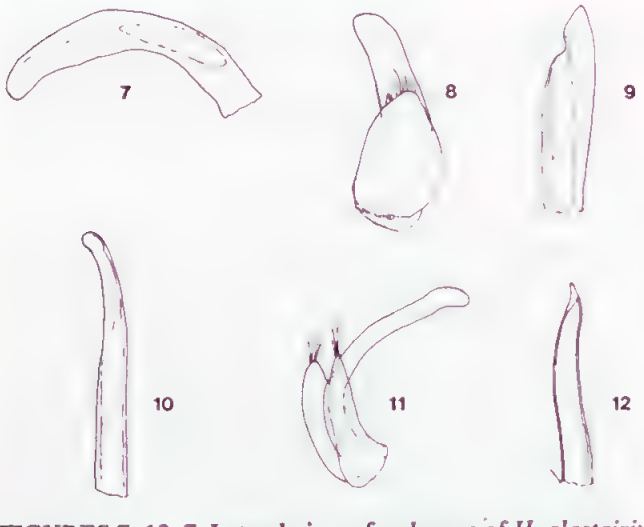
2. (1)<2.5 mm long; upper surface uniformly yellow-brown..... *sindus* sp. nov.
   >2.5 mm long; elytron usually with dark spots or markings 3

3. (2)Punctures and striae over most of elytron except laterally black, first interstria yellow-brown for most of its length (Figs 4 & 5). Elytral plicae weak, often reduced to 2–3 deeply impressed punctures..... *testudo* Clark
   First interstria of elytron black for most of its length; rest of elytra patterned as in Figs 1–3. Elytral plicae absent or short but well marked 4

4. (3) Elytral plicae short but well marked, elytron pattern as in Fig 3..... 5
   Elytral plicae absent; elytron pattern as in Fig. 3 ..... *nicholasi* sp. nov.



FIGURES 1–6. 1, Colour pattern on elytron of *H. alastairi*; 2, ditto *H. stepheni*; 3, ditto *H. nicholasi*; 4 & 5, ditto, *H. testudo* extreme examples; 6, dorsal view of *H. bistriatus* showing elytral and pronotal plica.



FIGURES 7–13. 7, Lateral view of aedeagus of *H. alastairi*; 8, dorsal view of aedeagus of *H. gibbus*; 9, dorsal view of aedeagus and paramere of *H. gibbus*; 10, ditto *H. alastairi*; 11, lateral view of aedeagus and paramere of *H. fuscatus*; 12, lateral view of aedeagus and paramere of *H. fuscatus*.

5. (4) 1–5 punctures in first interstria of elytron; 0–1 in third. Elytron without dark markings along anterior margin (Fig. 2) ..... *stepheni* sp. nov.
10-20 punctures in first interstria of elytron, 3–7 in third. Elytron without dark markings along anterior margin (Fig. 1) ..... *alastairi* sp. nov.

6. (1) Elytral plicae moderately-well marked; pronotal plicae curved (Fig. 6)..... *bistriatus* Wehncke
Elytral plicae absent or virtually so; pronotal plicae straight 7

7. (6) Aedeagus broad (Figs 8 & 9) ..... *gibbus* Clark
Aedeagus narrow (Figs 11 & 12)... *fuscatus* Clark.

Haliplus sindus sp. nov.

Description (number examined 2)

Length 1.7 – 2.4 mm. Yellow-brown. Oval, broadest at shoulders, narrowing rather abruptly at apex. Elytron

weakly and broadly triangularly flanged about one quarter way from apex, tip sharply pointed, weakly serrated at shoulder. Head with scattered punctures about size of eye facets. Pronotum wider behind than in front, sides weakly convex when viewed from above, with scattered large punctures, hind margin produced backwards in a small nearly equilateral triangle in midline. Elytron smooth, shiny, with well marked strial punctures, stronger laterally, sutural stria small but distinct, a very few scattered interstrial punctures except in interstriae three–four and five–six which lack punctures. Elytral plicae short, crescent shaped, well impressed. Pronotal process flat, wider slightly behind, with large scattered punctures. Front portion of mesosternum weakly concave, broader than pronotal process with sides sharply undercut with scattered well marked punctures, sides of mesosternum with a few very large punctures, much smaller in midline. Coxal lobes more densely covered with punctures, large towards sides to very small in midline.

Types

Holotype, sex unknown. Qld. 'Bentinck Is. "Ninyilki" 6th June, 1963. P. Aitken, N.B. Tindale', in SAMA. Paratype F,1, 'Homehill Qld. 7.4.63 C.W.' in CW.

Distribution (Fig. 14)

Known only from the type localities.

Remarks

The small size and lack of pronotal plicae readily separate this rare species from other Australian *Haliplus*. It does not appear to be closely related to any other Australian species.

Haliplus nicholasi sp. nov.
(Fig. 3)

Description (number examined 4))

Length 3.3 – 4.1 mm. Oval, broadest at shoulders. Elytron only weakly tapering until final one third; apical one quarter weakly flanged and serrated; humeral angles weakly serrate. Head relatively broad between eyes; red-brown with scattered punctures about the size of eye facet; punctures at rear larger. Pronotum wider behind than in front, sides evenly diverging or slightly concave; strongly punctured particularly around margins, with an almost impunctate transverse band acrosspronotum behind middle; hind margin broadly triangularly produced in midline; reddish-brown. Antenna short, reaching to just behind middle of pronotum, five apical segments larger than rest, apical segment twice length of penultimate. Elytron reddish-brown with extensive black markings. Strial punctures on elytron large laterally, progressively weaker toward suture. Sutural punctures well marked, a little larger and much more numerous than those between stria one and two. Interstrial punctures small, sparse, absent from interstriae three to four. Elytral plicae absent, position marked by row of three or four punctures. Pronotal process flat, widening slightly toward rear, with scattered well marked punctures of varying size. Front section of mesosternum flat, not bordered by raised margin but margins sharply undercut; wider than pronotal process; punctured as on pronotal process; sides moderately covered with large punctures, much smaller towards midline. Coxal lobes more densely covered with punctures, those towards sides smaller than on sides of mesosternum, those towards midline about same size. Abdominal segments with one or two transverse bands of small to moderate punctures, apical segments with a few large punctures. Underside reddish-brown, legs a little darker.

Male: Protarsi a little exposed.

Types

Holotype, F 'Townsville, Qld. Feb 1972 T. Ingeldew', in NMV. Paratypes, 1. M. 'Homehill Qld. 7.4.63 CW'., 2FF. 'Cairns Qld. 16.4.63 CW' in CW.

Distribution

Fig. 14. Known only from the type localities near Cairns and Townsville in North Queensland.

Remarks

A little known species, resembling the widespread *H. testudo*. It is slightly smaller, has fewer interstrial punctures, and differently patterned elytra. The aedeagus of the only known male specimen has been lost. The pattern on the elytra resembles in some respects that in *H. signatipennis* Regimbart from new Guinea. *H. nicholasi* differs from this species (and from the other known new Guinea species, *H. ferruginipes* Regimbart) in lacking punctures between stria three and four, and in lacking the transverse depression at the base of the pronotum present in these species.

Haliplus testudo Clark
(Figs 4 & 5)

Haliplus testudo Clark, 1862, p. 400
Haliplus australis Clark, 1862, p. 400. Syn. after Watts, 1985 and re-examination of types.

Types

H. testudo. Lectotype, F. right hand specimen of two mounted on card. No locality, previously with BMNH type and syntype labels, here designated. Companion specimen designated paralectotype. *H. australis*. Lectotype, F. no data except hand written BM label, previously with BMNH type and syntype labels, here designated.

Description (number examined 118)

Length 3.2 – 4.1 mm. Oval, widest at shoulders, tapering towards apex of elytra, lateral margin of elytron serrate in apical one quarter. Head relatively broad between eyes, yellow to yellow-brown, moderately covered with punctures about same size or slightly larger than facets of eye. Antenna stout, reaching over half way back on pronotum, apical five segments noticeably larger than rest, apical a little longer than penultimate. Pronotum relatively short, wider behind than in front, lateral margins evenly diverging or slightly bowed out when viewed from above; unevenly covered with scattered moderate to large punctures which are densest around margins, with an almost impunctate band across pronotum behind middle; hind margin with small but well marked backward extension in midline; yellow to yellow-brown, some punctures particularly towards rear outlined in black. Elytron yellow to yellow-brown, punctures and usually stria also black. Strial punctures well marked, a little larger than those on pronotum, those in striae one to three smaller than others. Sutural punctures small but quite dense and well impressed, about size of those in interstria one to two. Interstrial punctures numerous, one third to half size of ones in striae, absent or very sparse in area between suture and first stria, alternate interstriae starting between striae three and four have fewer punctures with the more lateral ones virtually impunctate. Elytral plicae absent or represented by two to three enlarged sometimes contiguous punctures in stria five. Pronotal process broad, flat, diverging slightly behind, with well marked lateral ridges, sparsely punctured. Mesosternum sparsely punctured, punctures large, laterally subobsolete in midline; well-marked ridges running backwards from pronotal process for about half length of segment. Coxal lobes large, strongly punctured laterally, weakly in midline. Abdominal segments with one or two transverse rows of small punctures. Apical segments with some moderate to large punctures in apical half. Underside yellow-brown with darker motlings particularly at bases of legs.

Male: Basal two joints of protarsi a little expanded.

Variation: Some specimens reddish all over.

Distribution: (Fig. 14)

Coastal regions from Darwin to Melbourne. Also from Charleville, Qld.

Remarks

By far the commonest and most widespread Australian halipilid. A variable species with yellowish specimens predominating in the south and darker reddish specimens in the north. In some southern specimens the characteristic black pigment around elytral punctures and striae is greatly reduced (Fig. 4). In some there are vague darker patches on the elytron suggestive of *H. alastairi* or *H. nicholasi* but in all specimens that I have seen the dark elytral striae have been separated by yellow-brown. In all but a few examples the elytral plicae are virtually absent. The aedeagus is variable in lateral view, with some specimens, notably those from more southern localities, being much wider in the middle.Separable from the other species lacking pronotal plicae by characters mentioned under *H. alastairi* and *H. nicholasi*.

Haliplus alastairi sp. nov.
(Figs 1, 7, 10)

Description (number examined 16)

Length 3.0–3.6 mm. Oval, tapering quite rapidly behind shoulders. Humeral angle of elytron serrate, apical one quarter of elytron weakly flanged and weakly serrate. Head relatively broad between eyes, dark yellow-brown, moderately punctate; punctures larger than eye facets. Pronotum wider behind than in front; lateral margins evenly diverging when viewed from above; strongly punctured particularly around margins, with an almost impunctate band across pronotum behind middle and a row of three to six noticeably larger punctures above hind margin at each corner; hind margin with small sharply triangular extension in the midline; reddish brown. Antenna reaching beyond middle of pronotum, last five segments larger than rest, apical about 1.5x longer than penultimate. Elytron reddish brown, with dark-brown to black markings. Strial punctures will marked, about size of pronotal punctures, those in striae one to three smaller than others. Sutural punctures well marked, as large as and more numerous than punctures between striae one and two. Interstrial punctures rather sparse, about one quarter to one third size of those in adjacent striae, alternate interstrial starting from between striae three and four have fewer punctures with the more lateral ones impunctate. Elytral plicae short (three to four punctures long) but usually deeply impressed; punctures on humeral angle between plica and edge of elytron large and crowded. Pronotal process relatively narrow, flat, quite strongly punctured. Front portion of mesosternum a little wider than pronotal process, flat or even slightly convex, sides rounded, undercut but not ridged. Mesosternum rather sparsely punctured, punctures strong at sides, small but well-impressed in midline. Coxal lobes more densely but still only moderately covered with punctures, those at sides moderate, about size of those in stria on elytron, those towards midline small but well impressed. Abdominal segments with one or two transverse bands of moderate punctures, apical segment with a few larger punctures. Underside reddish with darker areas, particularly legs which are mainly dark red-brown.

Male: Two basal segments of protarsi a little expanded.

Variation: One specimen from Tambourine Mountain, Qld that I refer to this species has the elytral plicae reduced to short series of slightly enlarged punctures.

Types

Holotype, M. '12°36'S 132°52'E Magela Creek, N.T. 1 Km NNW of Mudginbarry HS. 25.v.73, Matthews & Upton' in ANIC. Paratypes: 1, 'Cardstone Qld 4-16. i-1966 K Hyde'. 1, 'Cooktown N.Q. 1/71 GB', 2, 'Katherine, N.T. at light. 9.ii.68 J.A.L. Watson', 1, 'King River, 2, 14°30'S.143°20' E.22.vi.68. F. Parker' all in ANIC. 1, 'Lake Buchanan Qld. 21°30'S 145°50'E B.Timms 25/9/83', in CW; 1, 'Cairns C.J.W.' in QM.

Distribution (Fig. 13)

The east coast of Cape York and the top end of the Northern Territory. If the specimen from Tambourine Mountain near Brisbane does belong to this species it may indicate a more extensive range down the Queensland coast.

Remarks

Morphologically close to *H. testudo*, *H. nicholasi* and *H. stepheni* but averaging smaller than the first two of these species (3.0 mm compared with 4.0 mm and 3.3 mm respectively) with a more spindle shaped and less parallel sided form. The elytral plicae are well marked in all the specimens I have seen whereas they are virtually absent in all but a few specimens of *H. testudo* and *H. nicholasi*. The larger number of interstrial punctures separate it from *H. stepheni*. The colour pattern on the elytron differs from these species. The aedeagus is very similar to that of *H. stepheni*. It is a little thinner in dorsal view to *H. testudo*.

Haliplus stepheni sp. nov.
(Fig. 2)

Description (number examined 13)

Length: 2.8–3.0 mm. Oval, tapering quite rapidly from about half way back on elytrae. Humeral angle of elytron serrate, apical quarter of elytron weakly flanged and weakly serrate. Head relatively broad between eyes, dark yellow-brown, shiny, moderately punctate, punctures larger than eye facet. Pronotum wider behind than in front; lateral margins evenly diverging when viewed from above except for extreme front portions; sparsely covered with large punctures, impunctate areas on disc, row of larger punctures along hind edge at each side, laterally depressed in middle near hind edge, hind margin with small triangular extention in the midline, coloured as on head. Antenna reaching nearly to elytron, last five segments larger than rest, apical about same length as penultimate. Elytron dark yellowish-brown, with well defined dark pattern (Fig. 2). Strial punctures well marked, about size of those on pronotum, those on disc smaller than others, sutural punctures numerous, well marked, about half the size of those in adjacent striae. Interstrial punctures small and sparce, those in alternate interstria starting from interstriae 1–2 very sparse, lateral areas impunctate. Elytron plica short, 3–6 punctures long, deeply impressed, punctures between plica and edge of elytron only a little longer than others and not particularly crowded. Pronotal process relatively narrow, flat, quite strongly punctured. Front portion of mesosternum a little wider than pronotal process, flat except for front edge which is sharply depressed, sides slightly undercut, sparsely punctured with a row of punctures on vertical surface along sides, center virtually impunctate. Coxal lobes more densely but still only moderately covered with punctures, those at sides about size of those in lateral elytral striae, those towards midline small but well impressed. Abdominal segments with one or two bands of small punctures, apical segment with a few larger punctures, underside reddish with darker areas, particularly legs which are mainly dark red-brown.

Male: Last five joints of antenna a little smaller.

Types

Holotype, M. 'AUSTRALIA, N.T. Humpty Doo, 6 km E., 9.ii-4. iii.1987. R.I. Storey' in SAMA. Paratypes same data, 8 in QPI, 2 in C.W.

Distribution

Known only from the type locality near Darwin, N.T.

Remarks

A strikingly marked species separated from *H. alastairi* and *H. nicholasi* by the extension of black markings along front margin of elytron. Some individuals also have a dark patch on the front edge of the pronotum in the midline. The presence of well marked elytral plicae distinguish it from *H. nicholasi* and the greatly reduced number of interstrial punctures from *H. alastairi*. The pronotum is more strongly folded than in the other species and there is a hint of a basal depression in some specimens. The aedeagus is very similar to that of *H. alastairi*. It is a little thinner in dorsal view to *H. testudo*.

Haliplus bistriatus Wehncke
(Fig. 6)

Haliplus bistriatus Wehncke, 1880, p. 72.

Types

None located. (They are not in BMNH nor Paris National Museum.)

Description (number examined 39)

Length 2.5–3.4 mm. Oval, sides of elytra subparallel in central half. Elytron weakly flanged in apical one quarter. Head relatively narrow; yellow-brown; sparsely covered with scattered small punctures about the size of eye facets. Antenna short, reaching to about middle of prothorax, apical five segments noticeably larger than rest, apical segment largest. Pronotum wider behind, sides weakly bowed outwards when viewed from above; hind margin widely triangularly produced backwards in middle; with well marked plica reaching one third way across pronotum, curving inwards; area between plicae depressed; strongly punctured, particularly at sides and at front; yellow-brown with front margin and area between plica darker. Elytron dark yellow-brown with striae, other than at sides, outlined in dark-brown to black. Striae composed of rather large well impressed punctures, those in inner two striae about half size of others. Interstrial area impunctate, sutural row of punctures sparse and very small. Elytral plica moderately marked, a little longer than pronotal plica. Pronotal process broad, with row of strong punctures along edges, concave in cross-section. Mesosternum raised in forward midsection, without lateral ridge but sharply undercut; front portion same width as pronotal process and slightly depressed in midline; midline with scattered small punctures, larger towards rear, lateral sections covered in many strong punctures. Punctures on coxal plate vary from very strong laterally to subobsolete in midline, largest slightly smaller than those at sides of mesosternum. Abdominal segments with small to moderate sized but well marked punctures; apical segment strongly punctured. Undersides dark yellow-brown with extensive dark mottlings.

Male: Protarsi a little expanded.

Distribution (Fig. 13)

Coastal Queensland from Brisbane to Cooktown.

Remarks

H. bistriatus appears to be relatively common in coastal Queensland where it is the only *Haliplus* with pronotal plicae and depressed basal area of pronotum. It is readily separated from the more southerly *H. gibbus* and *H. fuscatus* with which it shares these characters, by the larger and distinctly curved pronotal plicae and the presence of well marked, though short, elytral plicae. The aedeagus is distinctive. The type locality is given as Adelaide. In the absence of the type this must throw doubt on my identification of this Queensland species. However, the description fits this species particularly in the unique (in Australia) character of having both pronotal and elytral plicae. This species has also been recorded from New Caledonia by Fauvel (1883) whose specimens were identified by Wehncke.

Haliplus gibbus Clark
(Figs 8 & 9)

Haliplus gibbus Clarke, 1862, p. 400.

Type

H. gibbus, lectotype, M. with genitalia extracted, 'S. Aust. Bakewell 59/24', previously with BM(NH) type and syntype labels, in BMNH, here designated.

Description (number examined 32)

Length 2.4–3.2 mm. Widely oval. Lateral edges of elytra parallel in central half. Elytron weakly flanged in apical quarter. Head relatively narrow, yellow-brown, sparsely punctured with small punctures about size of eye facet. Antenna short, reaching to about middle of prothorax, ten segmented, apical segment largest, next four subequal and noticeably larger than rest. Pronotum wider behind, sides smoothly diverging or slightly bowed except for hind corners where subparallel for short distance, hind margin widely triangularly produced backwards in middle, well marked sharp plicae to one quarter to one third width of pronotum, subparallel or weakly converging, positioned in line with front corners of pronotum, area between plicae depressed, moderately punctate, punctures uneven in size and distribution small on disc large at sides, yellow-brown, with front margin and area between plica often darker. Elytron yellow-brown with striae on disc outlined in dark-brown or black, some specimens with vague darker patches on elytron, nine elytral striae composed of moderately impressed punctures, those on inner two or three striae weaker, interstriae impunctate, sutural punctures sparse, very small, elytral plicae absent but punctures at front of stria five close together and often with their lateral margins accentuated. Pronotal process broad, margins ridged, concave in cross section. Mesosternum raised, weakly longitudinally depressed on forward midsection, fornt corners wider than adjacent pronotal process with distinct tendency to be bulbous and delineated from rest of mesoternum by fine line running backwards for about half length of segment. Lateral lobes of mesoternum with a few very large punctures, midline with subsolete to moderate punctures, larger behind. Coxal lobes strongly punctured laterally, weakly so towards midline. Undersde yellow-brown often with considerable brown-black areas, paerticularly pronotal process, lateral areas of mesosternum, first three abdominal segments ane parts of legs. Abdominal segments weadly punctured except apical one which has a few stronger ones.

Male: Protarsi weakly expanded.

Distribution (Fig. 13)

The wetter areas of southern W.A., S.A., Victoria and Tasmania. A southern species. Populations of either

this species or *H. fuscatus* or some very similar species are also known from Lake Gailee in Central Queensland and near Katherine in the N.T. Unfortunately these are only represented in collections (CW & SAMA) by females so their taxonomic status is uncertain.

Haliplus fuscatus Clark
(Figs 11 & 12)

Haliplus fuscatus Clark 1862, p. 400.

Type

H. fuscatus, Holotype, F. no data, in BMNH, locality given as Adelaide by Clark.

Description (number examined 13)

As for *H. gibbus* except for the aedeagus which is much narrower.

Distribution (Fig. 13)

Victoria, S.A. (type) and Rottnest Island, W.A.

Remarks

Does not appear to be as common as *H. gibbus*, nor as widespread. I have been unable to separate this species from *H. gibbus*. Although only known for certain from Rottnest Island, W.A. and Victoria, further collecting will undoubtedly extend its known distribution (See also note under *H. gibbus*). The type of *H. fuscatus* is a female and as such I cannot assign it to either of the two species of southern Australian *Haliplus* with weak or absent elytral plicae and straight pronotal plicae. Future studies may well show that *H. fuscatus* is a synonym (senior) for *H. gibbus* and that the species described above as *H. fuscatus* is new. In a previous publication (Watts 1985) I listed *H. fuscatus* and *H. gibbus* as synonyms since I was unable to separate the types.

Acknowledgments

I thank the curators of the collections listed earlier for allowing me to examine specimens in their care. In particular, I thank M.E. Bacchus [BMNH] for sending type material and searching for the type of *H. bistriatus*. Mrs P. Kidd and Mrs D. Brunker typed the MS. Special thanks are due to Ms J. Thurmer for several of the illustrations and to Dr E. Matthews for comments on the manuscript.

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FIGURE 13. Distribution map of *H. fuscatus*, *H. bistriatus*, *H. alastairi* and *H. gibbus*.

FIGURE 14. Distribution map of *H. sindus*, *H. testdo*, *H. nicholasi* and *H. stepheni*.

OSTEOLOGICAL DIFFERENCES OF THE AXIAL SKELETON BETWEEN *LASIORHINUS LATIFRONS* (OWEN, 1845) AND *VOMBATUS URSINUS* (SHAW, 1800) (MARSUPIALIA: VOMBATIDAE)

G. G. SCOTT & K. C. RICHARDSON

SCOTT, G.G., & RICHARDSON, K.C. 1987. Osteological differences of the axial skeleton of *Lasiorhinus latifrons* (Owen, 1845) and *Vombatus ursinus* (Shaw, 1800) (Marsupialia: Vombatidae). *Rec. S. Aust. Mus.* **22** (1): 29–39.

Many of the bones from the axial skeleton of the extant hairy-nosed wombat, *Lasiorhinus latifrons* (Owen, 1845) and common wombat, *Vombatus ursinus* (Shaw, 1800) are statistically significantly different. The gross morphological features are summarised to facilitate rapid specimen identification at the generic level.

A number of newly recognised diagnostic differences are recorded: (i) atlas, (a) transverse processes, short and cylindrical in *L. latifrons*, but long and flat in *V. ursinus*, (b) cranial articular surface, dorsal border begins above root of transverse process in *L. latifrons*, but below in *V. ursinus*, (c) intervertebral foramen, small in *L. latifrons*, but large in *V. ursinus*, (d) neural arch, tubercle present at the apex in *L. latifrons*, but a sulcus in *V. ursinus*, (e) transverse foramen, almost enclosed by bone in *V. ursinus*, but open in *L. latifrons*, (f) lamina, cranial border flat in *L. latifrons*, but arched in *V. ursinus*;(ii) axis, (a) transverse processes, extend laterocaudally beyond caudal surface of vertebral body in *V. ursinus*, but terminate level with, or before, caudal surface of vertebral body in *L. latifrons*, (b) dens, directed craniodorsally, apex lies above dorsal surface of vertebral body in *L. latifrons*, but projects cranially, and apex lies below dorsal surface of vertebral body in *V. ursinus*; (iii) manubrium of sternum, (a) articular process for clavicle, conical in *L. latifrons*, but laterally flattened in *V. ursinus;* (b) clavicular notch, shallow in *L. latifrons*, but deep in *V. ursinus*. Significant differences in size were found for: (i) axis, lamina thickness, lamina diameter, dens length; (ii) thoracic vertebrae, dorsoventral diameter of body of all but the 3rd vertebra; craniocaudal diameter of vertebral body of 1st, 2nd, 7th, 9th, 10th, 11th, 12th and 13th vertebrae; (iii) lumbar vertebrae, maximum transverse process diameter of 1st, 2nd and 3rd vertebrae; (iv) sacral vertebrae, maximum transverse process diameter of 2nd, 3rd and 4th vertebrae; and (v) shaft diameter for ribs 11, 12 and 13.

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The common wombat *Vombatus ursinus* (Shaw, 1800) was first discovered by Bass on Clarke Island in Bass Strait in 1797. Although the skull aroused considerable taxonomic discussion from 1800, it was only in 1838 that Owen first described its axial skeleton. Owen added to this description in 1839. Subsequent work on the axial skeleton by Everett (1853) and Home (1853) provided no new information.

Even though the hairy-nosed wombat *Lasiorhinus latifrons* (Owen, 1845) was first discovered in 1845, it was in 1867 that Murie described its axial skeleton and compared it with *V. ursinus*. Other workers such as Lydekker (1894), Murie (1892) and Marlow (1965) confirmed, in part, many of Murie's (1867) findings, but added little to the existing information.

To date the descriptions of the axial skeleton of the two wombat genera have lacked adequate detail. In many instances, they were not accompanied by figures or definitions to allow ready specimen identification especially of isolated small bones.

This paper presents a number of newly recognised diagnostic features and incorporates, where valid, previously described diagnostic features.

Materials and Methods

Specimens

Bones of the axial skeleton of *L. latifrons* and *V. ursinus* were examined in the collections of the Australian Museum, Sydney; Museum of Victoria, Melbourne; Queensland Museum, Brisbane; South Australian Museum, Adelaide; and Western Australian Museum, Perth. For this study additional specimens of *L. latifrons* were collected at Blanchetown, Roonka and Swan Reach in South Australia; and of *V. ursinus* over the Great Dividing Range and adjacent regions.

Measurements

The morphology of the axial skeleton bones was examined and any diagnostic features not previously recorded in the literature noted. Both adult and juvenile specimens were examined, but only bones from adults were compared for diagnostic purposes. Linear measurements were made with vernier callipers on adult specimens.

Axial Skeleton Measurements

1. Atlas
   (i) lamina, craniocaudal diameter at summit;
   (ii) maximum dorsoventral height from apex of arch to ventral surface of body.

2. Axis
   (i) maximum dorsoventral height from apex of spinous process to ventral surface of body;
   (ii) lamina, thickness at point of maximum constriction dorsal to the caudal articular surface;
   (iii) lamina, craniocaudal diameter at point of maximum constriction dorsal to the caudal articular surface;
   (iv) dens, length from ventral surface to apex;
   (v) dens, maximum lateral diameter;
   (vi) vertebral body, dorsoventral diameter at midline;
   (vii) vertebral body, craniocaudal diameter, including dens, at midline;
   (viii) spinous process, length from apex of vertebral foramen to summit of spine.

3. Cervical Vertebrae
   (i) maximum combined diameter of the transverse processes.

4. Thoracic Vertebrae
   (i) vertebral body, dorsoventral diameter at midline;
   (ii) lamina, craniocaudal diameter at point of maximum constriction dorsal to caudal articular surface;
   (iii) spinous process, length from apex of vertebral foramen to summit of spine;
   (iv) maximum combined diameter of the transverse processes;
   (v) maximum dorsoventral height from apex of spinous process to ventral surface of body;
   (vi) vertebral body, craniocaudal diameter at midline.

5. Lumbar Vertebrae
   (i) maximum combined diameter of the transverse processes.

6. Sacral Vertebrae
   (i) maximum combined diameter of the transverse processes.

7. Coccygeal Vertebrae
   (i) maximum combined diameter of the transverse processes.
   (ii) vertebral body, craniocaudal diameter at midline.

8. Sternum
   (i) manubrium, craniocaudal length at midline:
   (ii) maximum diameter opposite articular surfaces for 1st ribs.

9. Ribs
   (i) shaft, maximum diameter immediately distal to tubercle.

Osteological terminology used is as in the *Nomina Anatomica Veterinaria* (Habel *et al.* 1983).

Analysis

Methodology includes Student's t-test, 2-'tailed', and bivariate analysis (Simpson *et al.* 1960). Bivariate regression analysis of specimens of known sex shows no significant sexual dimorphism for any of the characters examined, so measurements of both sexes were combined.

Results

General

Size range overlap exists between *V. ursinus* and *L. latifrons* for most measurements. However, *V. ursinus* is significantly larger for:

1. Axis, (i) lamina, dorsoventral thickness ($P<0.001$); (ii) lamina, craniocaudal diameter ($P < 0.001$);(iii) dens, length ($P < 0.001$).
2. Lumbar vertebrae, maximum combined diameter of the transverse processes of the 1st, 2nd and 3rd vertebrae ($P < 0.001$).
3. Sacral vertebrae, maximum combined diameter of the transverse processes of the 2nd, 3rd and 4th vertebrae ($P < 0.001$).

L. latifrons is significantly larger than *V. ursinus* for:

1. Thoracic vertebrae, (i) vertebral body, dorsoventral diameter, T2 and 11 ($P<0.001$);T1, 4, 6, 7 and 12 ($P < 0.01$); and T5,8, 9, 10 and 13 ($P < 0.05$); (ii) Vertebral body, craniocaudal diameter, T1 ($P<0.001$); and T2, 7, 9, 10, 11, 12 and 13 ($P < 0.05$).
2. Lumbar vertebrae, maximum combined diameter of the transverse processes of the 1st, 2nd and 3rd vertebrae ($P < 0.001$).
3. Sacral vertebrae, maximum combined diameter of the transverse processes of the 2nd, 3rd and 4th vertebrae ($P < 0.001$).
4. Ribs, shaft diameter of the 12th and 13th ($P<0.001$) and 11th ($P < 0.05$).

Axial skeleton measurements for both taxa are given in Tables 2–16.

Specific

Vertebral Column

As Owen (1839), Wood Jones (1923), Lydekker (1894), Murie (1867) and Marlow (1965) correctly pointed out, *V. ursinus* and *L. latifrons* possess different numbers of vertebrae in several parts of their vertebral column (Table 1).

Cervical Vertebrae

These are the smallest vertebrae, excluding the coccygeal vertebrae. Only the atlas and axis show any consistent gross morphological differences.

Linear measurements show no significant differences between the two wombat genera (Table 2.)

Atlas:

	L. latifrons	*V. ursinus*
Transverse process.	short and cyclindrical.	long and dorsoventrally flattened.
Cranial articular surface.	begins above level of transverse process.	begins below level of transverse process.
Intervertebral foramen.	small.	large.
Tubercle.	present at apex of neural arch.	absent, a sulcus.
Transverse foramen.	open.	almost enclosed.
Lamina.	cranial border flat.	arched.
Ventral arch incomplete.	V-shaped.	shallow.

Axis:

	L. latifrons	*V. ursinus*
Dens.	directed craniodorsally, apex lies above dorsal surface of vertebral body.	directed rostrally, apex lies below dorsal surface of vertebral body.
Spinous process.	short and thick.	long and narrow.
Transverse process.	terminates level with, or before, caudal surface of vertebral body.	terminates beyond caudal surface of vertebral body.

Significant size differences in the axis were found for; (i) dorsoventral lamina thickness, (ii) craniocaudal lamina diameter, and (iii) dens length (Table 3).

No gross morphological or significant size differences were found between the two taxa for the five caudal cervical vertebrae (Table 4).

Thoracic Vertebrae

These are morphologically similar in the two wombat taxa. *L. latifrons* is significally larger than *V. ursinus* in dorsoventral diameter of the vertebal body for the following vertebrae: T2 and 11 ($P<0.001$); T1, 4, 6, 7 and 12 ($P<0.01$); T5, 8, 9, 10 and 13 ($P<0.05$) (Table 5). There were no significant size differences between the two wombats for craniocaudal diameter of the lamina (Table 6), and length of the spinous process (Table 7). Maximal combined diameter of the transverse processes decreases from T1 to a minimum at the 12th vertebra in *V. ursinus*, but at the 13th in *L. latifrons*. There is no significant size difference between the measurements appearing in Table 8. Maximum dorsoventral height of the vertebrae also decreases caudally to a point of minimum size at the 13th vertebra in *V. ursinus*, but 12th in *L. latifrons*. There is no significant size difference between the measurements in Table 9. Contrary to this, craniocaudal diameter of the vertebral body increases caudally in both genera. *L. latifrons* is significantly larger than *V. ursinus* for vertebrae: T1 ($P<0.001$) and T2, 7, 9, 10, 11, 12, 13 ($P < 0.05$) (Table 10). Mammillary processes usually present at the 12th thoracic vertebra in *V. ursinus*, progressively increase in size to the second lumbar vertebra, then decrease in size to the end of the sacrum. In *L. latifrons* they were generally present at the 13th thoracic vertebrae then progressively increased in size to the fourth lumbar vertebra, and decreased in size to the end of the sacrum. This is only of diagnostic value when measurements for dorsoventral vertebral body diameter (Table 5) and craniocaudal vertebral body diameter (Table 10) are also available.

Lumbar Vertebrae

These are morphologically similar in the two wombat taxa. However, *V. ursinus* possesses four, but *L. latifrons* has six lumbar vertebrae (Table 11). Maximum combined diameter of the transverse processes of the first three vertebrae is significantly greater in *V. ursinus*; there is no size overlap between the two genera.

Sacral Vertebrae

In defining the number of sacral vertebrae in *V. ursinus*, Owen (1867) said:'if we regard those vertebrae only as sacral which join the ossa innominata then there are but three. If on the other hand, anchylosis is the test, then the sacral vertebrae may vary from 3 to 4–5, in number in different specimens'. On the anchylosis criterion none of the *V. ursinus* specimens that we examined had only three vertebrae, but the majority (46.1%, n = 22) possessed four. On the other hand three out of four of the *L. latifrons* specimens that we examined had four vertebrae. In addition, the *L. latifrons* sacrum is rostrally broader but narrows more sharply caudally i.e. the 5th vertebra is approximately

44% narrower than the 1st in *L. latifrons*, but 21% narrower in *V. ursinus*. There are no gross morphological differences in the individual vertebrae to distinguish them between the two wombat taxa. Linear measurements show significant differences for the following vertebrae: S2, 3 and 4 ($P<0.001$) (Table 12).

Coccygeal Vertebrae

There are no consistent gross morphological or significant size difference in the individual bones to distinguish them between the two wombat taxa (Tables 13 and 14).

Manubrium of the Sternum

Gross morphological differences in the manubrium of the two wombat genera were found in the following features:

	L. latifrons	*V. ursinus*
Articular process for the clavicle.	conical.	laterally flattened.
Clavicular notch.	shallow.	deep.

There were no significant size differences for measurements appearing in Table 15. Other sternebrae from the wombats were similar in form for each species.

Ribs

These are similar in the two wombat genera. The cranial ribs are more curved than those succeeding them, and maximum shaft diameter generally decreases caudally through the rib series. The rib shaft diameters for *V. ursinus* are significantly smaller than those for *L. latifrons* for ribs: 11 ($P < 0.05$), 12 ($P < 0.001$) and 13 ($P < 0.001$) (Table 16).

Discussion

Vertebral differences in the axial skeleton mirror variations in burrowing behaviour of *L. latifrons* and *V. ursinus*. For example, differences in the morphology of the atlas and axis are reflected in Angas' (1861) observation that *V. ursinus* does not hold its head as erect as does *L. latifrons* when standing. Indeed this is suggested by the dorsocranial orientation of the dens of the axis in *L. latifrons*, as well as by the presence on the skull of a well developed nuchal crest at the junction of the parietal and occipital bones for the attachment of *mm. rectus capitis*. In contrast the dens of *V. ursinus* is directed cranially and the parietal bone is flat. However, the transverse processes of the atlas of *V. ursinus* are very large indeed when compared to those in *L. latifrons*. This allows a greater surface area for muscle attachment, particularly *mm. obliquus capitis* and *mm. intertransversarii longus*, and probably facilitates a greater degree of head rotation, as well as more powerful lateral and dorsal head movements in *V. ursinus*.

As for the difference in the number of thoracic vertebrae and thus thoracic ribs, Owen (1838) believed that *V. ursinus* had the greater number i.e. 15 pairs of ribs because 'The pressure to which the trunk of the Wombat must occasionally be subjected, in its subterranean burrowings, is probably the condition of the development of the additional pairs of ribs'. Unfortunately *L. latifrons* is also 'a thorough adept in the art' of burrowing (Angas 1861).

The reason probably lies with *V. ursinus* being greater in body size. However, the point of minimum combined vertebral transverse process diameter, and minimum overall dorsoventral size of the vertebrae, which together indicate the centre of greatest spinal mobility, occurs at about the same point, the anticlinal vertebra, in the axial skeleton of both genera. This supports Slijper's (1946) conclusion that the inclination of the neural spine does not depend on the construction of the trunk in its entirety, but instead must be affected only by the demands of the muscles and ligaments attached to them. In other words, the reason for *V. ursinus* having 15 pairs of ribs, while *L. latifrons* only has 13 pairs, is a structural reflection of the need to transmit a greater visceral weight via the ribs, and the oblique and transverse abdominal muscles, directly to the body's axis than does *L. latifrons*.

Slijper (1946) also found that spinous process length is proportional to the mechanical demands of the body. They are on average, with the exception of thoracic vertebrae 6, 7 and 8, the longest in *L. latifrons*. This provides the added mechanical advantage of a longer lever to move the diaphragmatic vertebrae which, together with two fewer ribs, would undoubtedly increase the ability of *L. latifrons* to bend its body laterally into curving tunnels.

Unfortunately no mobility studies of the wombat vertebral column have yet been undertaken. But the general gross morphology of the cervical, thoracic and lumbar vertebrae suggest a shift in vertebral column mobility. The cervicals are very mobile in both dorsoventral and lateral directions, especially in the cranial part of the column, in both genera, because of the 'free' and 'unembracing' nature of the union between the pre-and postzygapophyses of successive cervical vertebrae. Thoracic vertebral mobility is particularly great in both genera.

However, the 14th and 15th thoracic vertebrae in *V. ursinus* are decidedly lumbar-like in appearance, but possess ribs! Indeed lumbar vertebrae numbers 3–6 in *L. latifrons* are more comparable in size to 1–4 in *V. ursinus* (Table 11). In both genera, lumbar vertebrae of the postdiaphragmatic region of the spine are much less mobile in the dorsal direction and almost absolutely immobile in the ventral direction. Lateral mobility is negligible, the vertebrae being 'locked'

together by their pre- and postzygapophyses. However, the mobility of the lumbosacral joint appears to be comparatively great in both directions in both genera, though the union between the two is more 'free' in *L. latifrons*.

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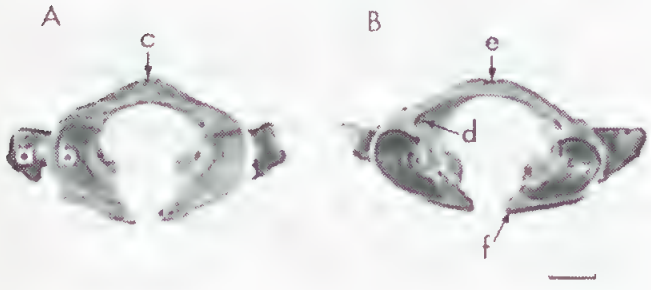

FIGURE 1. Atlas of (A) *L. latifrons* and (B) *V. ursinus*. Where a, transverse process; b, cranial articular surface; c, arrowed, dorsal tubercle; d, arrowed, intervertebral foramen; e, arrowed, dorsal sulcus; f, arrowed, incomplete ventral arch. Scale line is 1 centimetre.

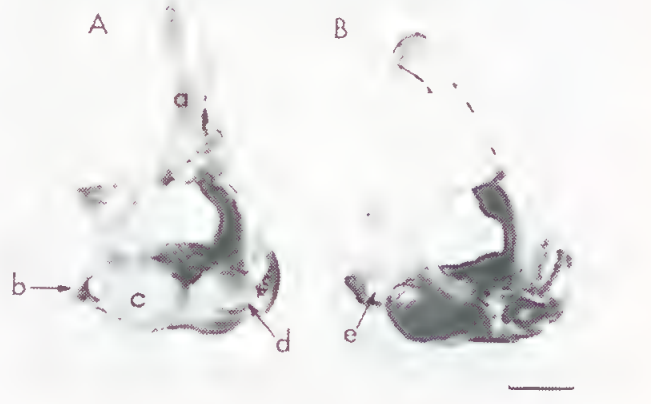

FIGURE 2. Axis of (A) *L. latifrons* and (B) *V. ursinus*. Where a, spinous process; b, arrowed, transverse process; c, cranial articular surface; d, arrowed, dens; e, vertebral foramen. Scale line is 1 centimetre.

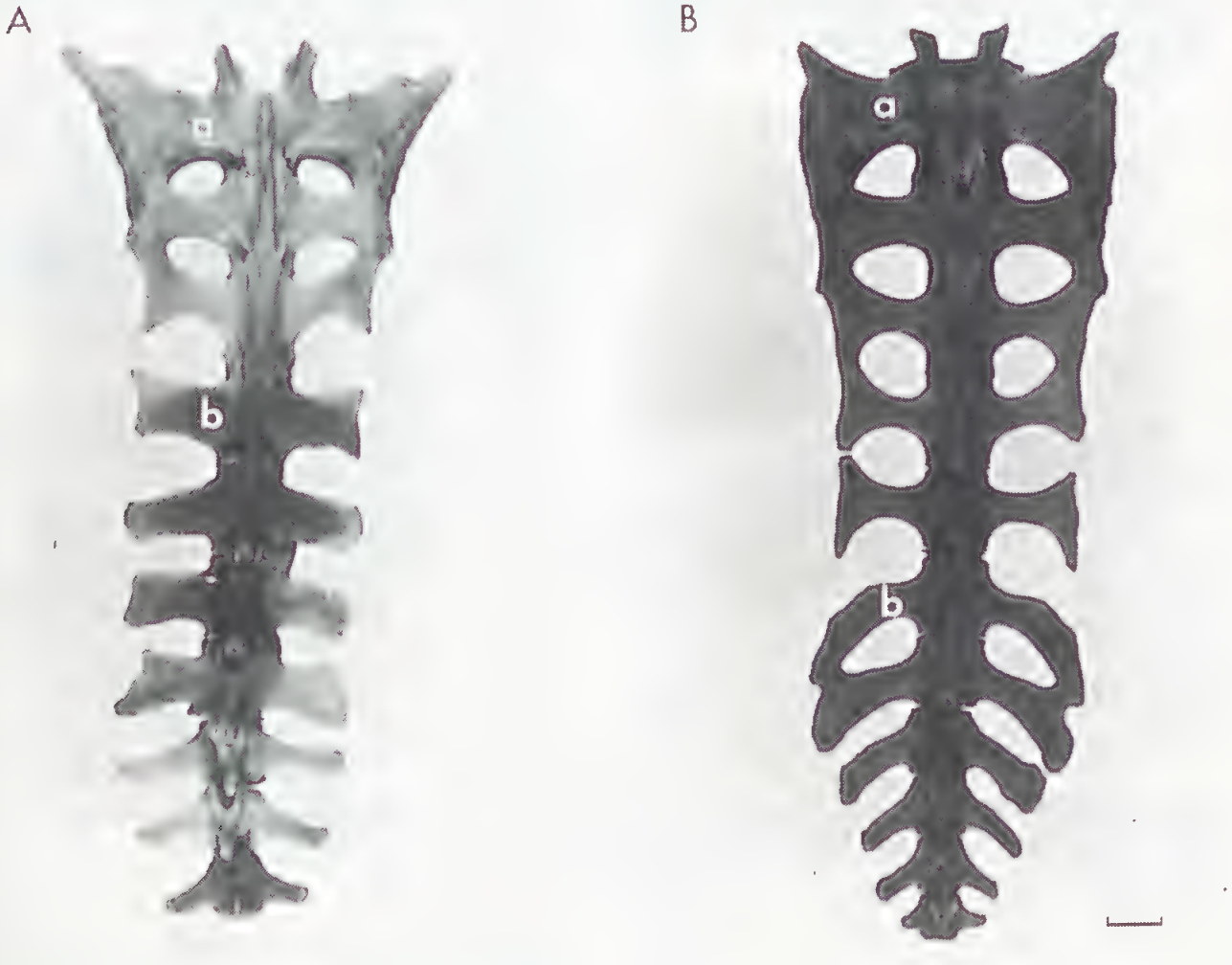

FIGURE 3. Sacral and coccygeal vertebrae of (A) *L. latifrons* and (B) *V. ursinus*. Where a, sacral vertebrae; b,coccygeal vertebrae. Scale line is 1 centimetre.

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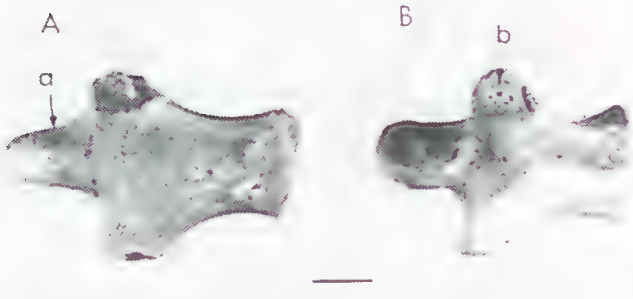

FIGURE 4.Manubrium of sternum of (A) *L. latifrons* and (B) *V. ursinus*. Where a, arrowed, articular process for clavicle; b, arrowed, articular process for 1st rib. Scale line is 1 centimetre.

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TABLE 1. Vertebral formula in *V. ursinus* and *L. latifrons*.

Vertebrae	*V. ursinus*	*L. latifrons*
cervical	7	7
thoracic	15	13
lumbar	4	6
sacral	4	4
caudal	10-12	15-16

TABLE 2. Atlas dimensions (mm) in *V. ursinus* and *L. latifrons*. Measurements: (1), craniocaudal diameter of the lamina; (2), maximum dorsoventral height of the vertebra.

Measurements (mm)	*V. ursinus*			*L. latifrons*		
	n	mean	sd	n	mean	sd
(1)	14	13.6	1.82	6	13.0	1.90
(2)	14	30.3	1.94	6	30.7	2.68

TABLE 3. Axis dimensions (mm) in *V. ursinus* and *L. latifrons*. Measurements: (1), maximum dorvosentral height of the vertebra; (2), dorsoventral thickness of the lamina; (3), craniocaudal diameter of the lamina; (4), dens length; (5), maximum lateral diameter of the dens; (6), dorsoventral diameter of the body; (7), craniocaudal diameter of the vertebral body; (8), spinous process length.

Measurements (mm)	*V. ursinus* n	mean	sd	*L. latifrons* n	mean	sd	
(1)	20	45.7	2.23	8	42.3	3.60	
(2)	19	3.1	0.56	7	2.6	0.40	***
(3)	21	11.2	0.72	8	9.1	1.60	***
(4)	19	9.7	1.01	6	7.9	0.78	***
(5)	20	8.0	0.72	9	8.0	1.15	
(6)	20	10.9	0.88	8	10.0	1.88	
(7)	19	26.5	1.20	8	26.0	2.02	
(8)	17	28.6	2.07	7	25.4	4.20	

*** $P < 0.001$

TABLE 4. Cervical vertebrae, maximum combined diameter of the transverse process (mm) in *V. ursinus* and *L. latifrons*.

Measurements (mm)	*V. ursinus* n	mean	sd	*L. latifrons* n	mean	sd
C 1(atlas)	14	63.3	4.09	5	55.6	4.11
2 (axis)	17	37.3	1.69	4	35.8	0.67
3	18	41.7	2.67	7	42.4	2.31
4	18	50.0	2.93	5	47.3	2.69
5	21	55.3	3.44	6	49.7	2.64
6	19	58.1	2.79	4	53.2	3.18
7	19	59.2	2.94	5	52.5	1.52

TABLE 5. Thoracic vertebrae, dorsoventral diameter of the vertebral body (mm) in *V. ursinus* and *L. latifrons*.

Measurements (mm)	*V. ursinus* n	mean	sd	*L. latifrons* n	mean	sd	
T 1	9	10.2	0.62	4	11.5	0.99	**
2	11	10.8	0.46	4	12.7	0.99	***
3	11	11.1	0.72	4	13.2	2.38	
4	12	11.2	0.62	3	13.7	2.16	**
5	12	11.1	0.74	4	12.7	1.99	*
6	12	11.1	0.68	4	12.8	1.69	**
7	12	11.1	0.80	3	12.8	1.40	**
8	11	11.1	0.82	4	12.4	1.41	*
9	10	11.2	0.78	4	12.4	1.18	*
10	9	11.2	0.81	4	12.5	1.19	*
11	11	11.1	0.86	4	13.0	0.80	***
12	11	11.7	0.92	4	13.5	1.15	**
13	11	12.1	0.96	4	13.7	1.08	*
14	11	12.9	1.17				
15	8	13.5	1.37				

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

TABLE 6. Thoracic vertebrae, craniocaudal diameter of the lamina (mm) in *V. ursinus* and *L. latifrons*.

Measurements (mm)	*V. ursinus* n	mean	sd	*L. latifrons* n	mean	sd
T 1	8	9.1	0.70	5	9.7	0.89
2	11	11.6	0.89	5	11.6	1.60
3	11	14.9	0.99	5	14.1	2.21
4	12	15.7	0.99	4	14.9	2.01
5	12	16.2	2.24	4	15.1	2.53
6	12	17.9	2.22	5	16.1	1.10
7	12	18.0	2.00	4	16.5	2.27
8	11	17.7	1.90	4	1.71	2.05
9	10	17.0	2.21	4	18.2	2.04
10	9	15.8	1.56	4	17.8	1.45
11	11	16.1	1.63	4	19.4	2.08
12	11	16.1	1.66	4	19.0	2.53
13	11	16.7	1.70	4	18.9	2.32
14	11	17.1	1.57			
15	8	17.5	2.47			

TABLE 7. Thoracic vertebrae, length of the spinous process (mm) in *V. ursinus* and *L. latifrons*.

Measurements (mm)	*V. ursinus* n	mean	sd	*L. latifrons* n	mean	sd
T 1	8	43.8	1.74	4	48.7	3.49
2	10	43.5	1.72	3	48.9	2.54
3	10	42.0	1.26	4	46.4	4.25
4	11	45.2	1.63	4	47.6	4.02
5	10	47.5	2.41	3	50.8	2.62
6	12	48.2	3.69	5	47.2	3.53
7	11	46.1	5.21	4	45.0	5.35
8	10	42.7	2.82	4	41.0	7.39
9	10	39.6	4.45	3	40.7	2.83
10	9	34.6	2.90	4	34.9	3.63
11	10	31.3	5.32	3	32.0	6.67
12	11	26.9	2.48	3	29.5	5.66
13	10	25.0	2.12	3	26.9	5.12
14	11	23.5	1.70			
15	8	22.9	2.25			

TABLE 8. Thoracic vertebrae, maximum combined diameter of the transverse processes (mm) in *V. ursinus* and *L. latifrons*.

Measurements (mm)	*V. ursinus* n	mean	sd	*L. latifrons* n	mean	sd
T 1	10	56.2	2.80	5	50.8	4.91
2	12	48.9	2.00	5	43.1	3.78
3	13	45.7	2.53	5	39.0	2.46
4	12	43.0	2.36	4	39.3	3.76
5	12	41.0	2.90	4	37.7	1.65
6	12	38.2	1.73	5	35.8	2.01
7	12	36.5	1.47	4	34.5	1.96
8	11	35.0	1.22	4	35.2	2.01
9	10	35.2	1.28	4	34.1	2.77
10	10	34.3	1.23	4	32.6	2.58
11	12	33.0	1.60	4	32.7	3.83
12	12	32.7	1.50	4	32.6	3.34
13	12	33.9	2.01	4	31.6	1.40
14	12	36.5	2.48			
15	9	39.0	2.58			

TABLE 9. Thoracic vertebra, maximum dorsoventral height (mm) in *V. ursinus* and *L. latifrons*.

Measurements (mm)	*V. ursinus* n	mean	sd	*L. latifrons* n	mean	sd
T 1	9	52.3	5.16	4	59.0	6.79
2	11	49.6	4.59	3	51.4	7.30
3	10	45.6	3.67	3	50.0	6.54
4	11	44.5	2.86	3	50.5	5.17
5	9	43.7	1.21	3	50.5	7.09
6	12	43.1	1.84	4	51.9	5.40
7	12	42.7	1.87	3	52.8	5.71
8	10	42.7	2.27	4	49.8	4.88
9	10	42.4	2.13	3	47.9	3.12
10	9	41.6	2.08	4	45.4	1.68
11	11	41.6	2.74	3	44.5	3.68
12	11	40.9	2.40	3	43.9	4.37
13	11	40.7	2.13	3	44.0	5.14
14	11	41.3	1.60			
15	8	43.7	1.94			

TABLE 10. Thoracic vertebrae, craniocaudal diameter of the vertebral body (mm) in *V. ursinus* and *L. latifrons*.

Measurements (mm)	*V. ursinus* n	mean	sd	*L. latifrons* n	mean	sd
T 1	11	10.8	0.94	4	12.8	0.69 ***
2	13	13.3	0.77	4	14.9	1.68 *
3	14	14.5	105	4	15.5	1.77
4	13	14.5	1.04	3	15.9	1.46
5	13	14.7	1.29	4	15.8	2.29
6	13	15.1	1.14	4	1.67	1.38
7	13	15.5	1.18	3	17.4	0.35 *
8	12	16.2	1.08	4	17.1	2.17
9	11	16.4	0.97	4	18.3	1.59 *
10	11	16.6	1.23	4	19.5	2.17 *
11	11	17.0	1.30	4	20.6	2.38 *
12	13	17.4	1.11	4	20.9	3.00 *
13	13	17.6	0.98	4	21.7	3.32 *
14	13	18.5	1.43			
15	10	19.7	1.25			

* $P < 0.05$; *** $P < 0.001$

TABLE 11. Lumbar vertebrae, maximum combined diameter of the transverse processes (mm) in *V. ursinus* and *L. latifrons*.

Measurements (mm)	*V. ursinus* n	mean	sd	*L. latifrons* n	mean	sd
L1	17	69.6	5.00	4	48.0	2.90 ***
2	16	88.9	6.39	4	61.3	4.78 ***
3	16	98.5	6.77	4	73.3	5.83 ***
4	14	90.3	6.45	4	88.4	9.26
5				3	91.5	9.45
6				3	92.8	2.38

*** $P < 0.001$

TABLE 12. Sacral vertebrae, maximum combined diameter of the transverse processes (mm) in *V. ursinus* and *L. latifrons*.

Measurements (mm)	*V. ursinus* n	mean	sd	*L. latifrons* n	mean	sd	
S 1	13	78.7	5.73	4	82.4	3.30	
2	13	69.0	3.93	4	59.8	3.08	***
3	13	66.7	4.39	4	50.8	3.57	***
4	13	64.1	3.62	4	51.4	4.20	***
5	7	62.6	3.34	1	46.2	0.00	
6	2	58.8	0.00				

*** $P < 0.001$

TABLE 13. Coccygeal vertebrae: maximum combined diameter of the tranverse processes (mm) in *V. ursinus* and *L. latifrons*.

Measurements (mm)	*V. ursinus* n	mean	sd	*L. latifrons* n	mean	sd
Co 1	12	58.5	4.92	3	48.8	2.77
2	13	56.5	5.13	3	52.2	2.74
3	11	47.6	5.14	3	47.4	1.72
4	12	39.1	3.14	2	44.5	0.00
5	9	30.8	2.45	2	38.6	0.00
6	5	19.7	4.68	3	31.1	1.53
7	2	11.6	0.00	1	18.0	0.00
8				1	10.6	0.00
9				1	7.0	0.00

TABLE 14. Coccygeal vertebrae, craniocaudal diameter of the vertebral body (mm) in *V. ursinus* and *L. latifrons*.

Measurements (mm)	*V. ursinus* n	mean	sd	*L. latifrons* n	mean	sd
Co 1	11	17.9	0.64	3	17.2	1.07
2	13	17.1	0.80	3	16.5	1.40
3	12	16.2	0.56	3	16.4	0.67
4	13	15.0	0.88	2	15.0	0.00
5	11	13.8	1.06	2	14.3	0.00
6	6	11.2	1.42	3	13.9	1.46
7	2	8.2	0.00	1	11.2	0.00
8	1	7.0	0.00	1	8.8	0.00
9				1	6.1	0.00

TABLE 15. Sternum, manubrium dimensions (mm) in *V. ursinus* and *L. latifrons*. Measurements: (1), maximum craniocaudal lengths; (2), maximum diameter opposite the articular surfaces for the 1st ribs.

Measurements (mm)	*V. ursinus* n	mean	sd	*L. latifrons* n	mean	sd
(1)	11	44.3	3.10	3	46.0	7.80
(2)	11	32.9	2.72	3	28.9	5.08

TABLE 16. Rib diameter (mm) in *V. ursinus* and *L. latifrons*.

Measurements (mm)	*V. ursinus* n	mean	sd	*L. latifrons* n	mean	sd	
1	7	10.1	1.12	6	8.8	0.33	
2	12	8.4	0.61	4	7.9	1.16	
3	13	8.4	0.67	11	8.5	0.68	
4	13	8.4	0.78	9	7.9	0.80	
5	11	8.2	0.84	5	8.1	1.27	
6	9	8.3	0.77	6	8.5	1.11	
7	11	7.9	0.48	7	7.9	1.17	
8	11	7.8	0.53	6	8.1	0.60	
9	11	7.2	0.51	6	7.4	0.29	
10	8	7.1	0.77	5	7.5	0.65	
11	11	5.3	1.15	5	6.7	0.81	*
12	11	4.5	1.01	6	6.3	0.30	***
13	9	4.3	0.46	6	5.5	0.60	***
14	9	4.5	0.98				
15	5	5.1	0.63				

* $P < 0.05$, *** $P < 0.001$

AUSTRALITES FROM THE VICINITY OF FINKE, NORTHERN TERRITORY, AUSTRALIA

W. H. CLEVERLY

CLEVERLY, W.H. 1988. Australites from the vicinity of Finke, Northern Territory, Australia. *Rec. S. Aust. Mus.* **22** (1): 41–48.

Australites from the vicinity of Finke, Northern Territory, are generally larger and less weathered than those of inland localities in Western Australia. Specific gravity studies show the presence of two populations, one of which contains the larger australites. Amongst notable specimens is one derived from a button which had an exceptionally large spherical primary body nearly 36 mm in diameter.

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The australites considered in this paper form the major part of the Finke Collection which is registered under T1308–T1341, T1343–T1369, T1375–T1389 and T1393–T1407 in the tektite collection of the South Australian Museum, Adelaide. The australites were acquired by purchase in 1972 from the former Apatula Mission located at Finke, N.T. (134°34'E, 25°35'S).

Ms J.M. Scrymgour of the South Australian Museum took a representative grab sample and chose other australites from the parcel available for sale, which she estimated to number between 10 000 and 12000. When choosing specimens, the most weathered and 'shapeless' were excluded which increased slightly the classifiable percentage in this material.

Some of the largest and most interesting specimens had been sold before the residue was offered to the Museum. It was inescapable, therefore, that even the grab sample should be representative only of the residue and that the chosen material should have been both degraded by prior sales and further affected by selection.

Mr G. McTavish of the Apatula Mission stated that nearly all the australites were found 'within 30 miles' (48 km) of Finke (Fig. 1), but the distance is certainly vague, being hearsay from Aboriginal collectors, and the intensity of occurrence and/or collection may have varied greatly with direction from the Mission. An exception are the 18 specimens from the more southerly localities named in Fig. 1 outside the 48 km radius. The 1838 specimens of the Finke collection may be reduced by these 18 and the 9 spurious ones detected to leave 1811 from the vicinity of Finke. The 1811 comprise the representative sample of 304 (T1389) and 1507 chosen specimens. Differences between these two groups and from the original parcel are to be expected. Thus there are 40.2% of essentially complete australites of mean weight 4.4 g in the grab sample and 45.7% of mean weight 4.2 g in the chosen material. The effects of prior sales cannot be estimated. In view of these uncertainties, the 1811 specimens are henceforth treated as a single unit, but the inherent bias needs to be considered when making comparison with samples from elsewhere.

Finke is near the northern boundary of the australite strewnfield, whichever of several suggested boundaries is preferred. It is the most northerly centre in its longitude around which australites have been found in quantity. There is partial overlap of the provenance with that of the Kennett Collection which is also held by the South Australian Museum. All localities of the small excluded southern group of the Finke Collection lie within the provenance of the Kennett Collection (Fig. 1) and some of them were visited by Mr Kennett in his collecting (Fenner 1940).

The large number of australites known from the Finke and Charlotte Waters regions (~18 000–20 000) may appear remarkable but a huge area is also involved. The average density represented is only about one australite per square kilometre. A larger number has been collected from a very much smaller area in Western Australia (Cleverly 1986).

Morphology

A morphological classification of the 1811 australites is presented in Table 1 using the system of Cleverly (1986). Representatives of 30 of the 48 recognised shape types are present, a large number considering the severity of the climate in central Australia. However, only 17 shape types, a more realistic number, are present in the grab sample.

Extracts have been made from Table 1 for comparison in Table 2 with a sample from Edjudina Station (centred 122°21'E, 29°49'S), a typical inland area of Western Australia from which a sample of comparable size is available. The percentage of classifiable specimens (Table 2) is distinctly higher at

Finke. This percentage varies with the degree of exactitude written into the system of classification, but when the same system is used by the same person, the principal residual cause of difference between representative samples is the intensity of weathering and erosion. There is some evidence that the lesser degree of weathering of the Finke australites is real rather than the result of bias in the sample. There are 49 specimens in the Finke collection showing radial secondary schlieren on the anterior surface. Such schlieren are particularly sensitive indicators of the degree of weathering because they were within the last film of migrating secondary melt, a layer only a few tenths of a millimetre thick. The schlieren are made more evident by light differential etching but are readily removed by abrasion. There do not appear to be any published abundance figures but personal experience is that it would be unusual to find more than a fraction of that number in a collection of comparable size from inland Western Australia. One only such specimen was found in 1883 australites from Edjudina Station. Nor is it likely that all such specimens could have been selected for the Finke Collection unless the large parcel were scrutinized exceptionally carefully. Even if this were so, the abundance would be about 8 per 1883 of the original parcel, i.e. 8 times that at Edjudina.

The percentages of the plan view shapes (round, oval and so on) are much the same at Finke as at Edjudina Station (Table 2), but this similarity may perhaps extend to any locality for which a sufficiently large and representative sample is available. However, the elevational shape abundances differ markedly. Flanged and allied fragile forms and indicators still in progress towards more stable lens and core forms total 13.9% at Finke against only 2.8% at Edjudina Station (Table 2). Even in the degraded grab sample the total is 5.7%, confirming the lesser degree of weathering at Finke.

The mean weight of 4.24 g for complete specimens is rather high but there is evidence in the core/lens abundance ratio of 0.74 (and 1.26 in the grab sample) compared with only 0.49 at Edjudina that a high mean weight was to be expected.

In summary, the less weathered condition and larger mean weight of the Finke specimens compared with those from Edjudina Station are at least partly real rather than the result of bias in the sample.

Specific gravity

The specific gravity (S.G.) is of special interest because Chapman *et al.* (1964) found that the frequency diagram of S.G. for the Kennett Collection from an adjoining and partially overlapping provenance is bimodal, suggesting the presence of two australite populations. They further noted that the difference between component populations was one of size only. The 28 large cores investigated by them belonged to the component of lower density, whilst medium-sized lenses and small cores included both components. Subsequently Chalmers *et al.* (1976: 32) noted the presence of two components further south in the Lake Torrens – Lake Eyre region and drew attention to the explanation offered initially by Summers (1913) that a band of australites of low S.G. is present between Victoria and the Lake Eyre region and a more widely distributed population of higher S.G. A frequency diagram for a sample of 202 specimens from Finke (Fig. 2) is also bimodal but differs in detail from both the preceding.

If only one of the populations contains large individuals of low density, its existence should be evident on a mass–S.G. scatter diagram, but attention is first drawn to a relationship between mass and S.G. which is compounded with variation resulting from the chemistry. Australites contain bubble cavities of a range of size and irregular distribution. It is therefore expected that the largest individuals of a population as the largest samples of a heterogeneous material will have the best chance of representing average material for that population and will show a relatively small variation in S.G. from one specimen to another. When successively smaller sizes are considered, the ratio of surface to volume increases, and with it the probability that cavities will be breached; hence the upper limit of S.G. rises. But simultaneously, if cavities of significant size are present but are not exposed, their effect upon the S.G. is greater than for large australites and the lower limit falls. Thus the entire range of S.G. is extended. For example, 29 unusually large australites from south-western Australia (Cleverly 1974, 1981; Cleverly & Scrymgour 1978; Scrymgour 1978) of average mass exceeding 170 g have specific gravities extending over a range of only 0.3 units whilst a sample of 46 specimens from Kulin West, which is about central to the region, and of mass ranging down to 1 g have S.G. values extending over 0.6 units. Thus, for a large sample, if mass is plotted as ordinate against S.G. as abscissa, the points representing individuals are likely to fall within a triangular area with its base on the x-axis, the largest individuals with small variability of S.G. occupying the apical region and the smallest ones occupying the broader base of the triangle.

There may also be an effect related to sample size. A numerically small sample usually shows a small variation in S.G. but a larger sample may contain the more extreme and rarer variations in size and chemistry and hence show a larger range of S.G. This effect is unlikely to be a major cause of difference when the sample numbers (29 and 46 in the above example) are of the same order.

Consider now the scatter diagram for the Finke sample (Fig. 3). The log-linear plot accommodates the large range of mass in which the number of individuals

decreases rapidly with increase in mass, but has the effect of bending the sides of the two triangles which may be visualized as enclosing all except two points. One of the exceptional points could be accounted for by a bubble cavity in the order of 4 mm diameter; the other exceptional specimen is perhaps an import to the area. To assist in defining the apices of the triangles, the S.G's of 27 additional large specimens were determined. The apices are approximately on the modal S.G. values previously established. Most of the larger specimens including all those weighing more than 28 g are in the triangle corresponding to the lower mode and it is also clear from the frequency polygon for larger specimens in Fig. 2 that their contribution is especially to the lower mode. There are thus two australite populations. The one of lower modal S.G. has a larger range of size than the one of high modal S.G.

Notes on Individual Specimens

Folded Bowl T1346

Dimensions 11.5 x 4.6 x 7.1 mm. Weight 0.431 g. Small bowls sometimes failed during a late stage of ablation flight by folding on a hinge, the opposing sides folding backward away from the pressure on the convex anterior surface (Cleverly 1979). The least folded specimens simply show undulation of the rear margin. More intensely folded specimens show the sides increasingly high relative to the ends of the hinge until contact is made at the mid-point of the 'lips'. This last is the degree of folding shown by the Finke specimen (Fig. 5 A1–A4), which has an elliptical area of fused contact *c.* 4 x 1 mm representing about 10% – 15% of the area of the sides. The calculated original dimensions of the bowl (Cleverly 1977) are very approximate because of somewhat asymmetrical folding and distortion. It was a round or slightly oval bowl, *c.* 10 x 9 x 5 mm (Fig. 4A and B).

Buttons T1311 and T1314

The button T1311 (Fig. 5 B1–B3) is one of several which are surprisingly well preserved. The state of preservation has prompted the making of some measurements and calculations relating to the primary body and its secondary development for comparison with buttons from Victoria. The less well-preserved button T1314 (Fig. 5C) was also measured and calculated. The results for this second button are placed in brackets immediately after those of T1311.

The radius of the primary sphere (Fig. 4C) was determined from two traverses of the posterior surface of flight in planes normal to the surface and at right angles to each other using a travelling vernier microscope. This tedious method has the advantage over projection of an enlarged profile that observations are made on parts which would otherwise be obscured by flange, thus reducing the risk that an oblately spheroidal primary body will be mistaken for a sphere. The radii are 8.6 (10.5) mm and 8.8 (11.0) mm. Using the mean radius, the primary sphere had volume 2.76 (5.20) cm^3 and the mass was 6.66 (12.77) g, provided that the primary sphere had the same S.G. 2.415 (2.449) as the button formed from it.

The radius of curvature of the anterior surface, which is complicated by the presence of flow ridges, was determined from profiles projected with a lantern. These profiles in the same planes as the traverses of the posterior surface have radii 11.2 (13.7) mm and 11.0 (12.7) mm respectively. The volume of the body of the button (i.e. the button less the flange) was then calculated as 1.18 (2.57) cm^3 by regarding the body as comprising segments of two spheres of known radii, base to base.

The volume of the button was calculated as 1.72 (3.20) cm^3 from loss of weight in pure toluene at known temperature and thus of known S.G. Hence by difference, the volume of the flange is *c.* 0.54 (0.63) cm^3.

The volume of the secondary body at the time when the frontal surface first encroached upon the 'equator' of the primary sphere was calculated as 1.82 (3.65) cm^3 by the same method as for the body. It was assumed that curvature of the anterior surface was the same then as now (dotted line of Fig. 4C), an assumption likely to only approximately correct. From that time onward the flanks of the secondary body, previously divergent rearward, became increasingly convergent. Melt stripped from the anterior surface could be caught in the eddy currents behind the leading edge and curled into the protective 'shadow' of the cooler posterior surface i.e. flange-building could commence.

Since the volume of the body is 1.18 (2.57) cm^3, the volume of material stripped from the anterior surface during the potentially flange-forming stage was 0.64 (1.08) cm^3. The flange volume is 0.54 (0.63) cm^3 and therefore 85% (59%) of the stripped material was retained upon the button as flange.

The above may also be expressed in terms of percentages of the volume of the primary sphere. Thus the total loss from the frontal surface was 57.1 (50.6)%, but 19.7 (12.2)% was retained as flange, so that the volume of the button and net loss from the primary body are: –

100 – 57.1 + 19.7 = 62.6%	Loss 37.4%
(100 – 50.6 + 12.2 = 61.6%	Loss 38.4%)

These figures are within the wide limits found by Baker (1962) for buttons from Victoria.

Buttons T1309

One specimen (Fig. 5D) has a distinct roll in the posterior surface of the flange and a gap beneath it suggesting that whilst still hot the flange was partially detached and pushed backward. A similar specimen has been noted and illustrated by Fenner (1940: 174 and Pl. IV, Ala 7 and 10), but whether an entrapped

bubble was the cause of weakness and detachment or whether the air-filled gap is the result of the detachment is not clear.

The other specimen (Fig. 5 E1 and E2) has a distinct gap in the flange. Two possibilities are suggested :

(i) This is a stage beyond that of the previous specimen and a short length of flange was completely detached. If so, it is puzzling that orientation should have been maintained and the scar smoothed by further ablation. Flow ridges are continuous around the dip in the edge (Fig 5 E2).

(ii) The specimen is one half of a symmetrical flanged dumbbell which was ablated to the stage of separation. Again, the maintenance of orientation presents a problem though it would need to persist only briefly after separation to smooth the break.

Round indicator I T1375

This specimen (Fig. 5 F1 to F3) derived from a button is uniquely large for its type amongst the estimated 60 000 australites which the writer has examined. It has dimensions 35.7 x 29.3 x 20.5 mm including the surviving remnants of stress shell and flange. Mass 21.326 g, S.G. 2.438. The primary sphere had diameter 35.9 mm, volume *c.* 24 cm^3 and mass *c.* 59g on the assumption that it had the same S.G. as the indicator.

The manner of development of secondary bodies is size-dependent. The largest primary bodies were not ablated to an extent sufficient for flanges to form but they usually shed the stress shell spontaneously to become cores. Primary bodies of medium to small size were ablated to the stage when a flange could develop but the total expansion and contraction were less than for large bodies and the stress shell was usually retained, perhaps to be lost later together with flange during terrestrial residence. The upper limit of size for the medium group is usually placed at about 30 mm diameter for spheres or 30 mm thickness for other bodies measured parallel to the line of flight. Thus, for example, the largest primary sphere of 23 buttons studied by Baker (1962: 277) was 27.1 mm diameter.

The large round indicator I draws attention to a shadowy and ill-defined category of behaviour between the medium-sized 'flange-forming' primary bodies and the larger 'core-forming' primary bodies. The 30 mm dimension is not necessarily the upper limit of size for bodies which developed flanges but only the usual limit for those with incontrovertible evidence of having done so. The larger the body, the more readily would it discard the stress shell with the flange. Baker (1962: 302) has listed a round indicator I derived from a primary sphere 34.7 mm diameter. That specimen and the one under discussion with primary sphere 35.9 mm diameter represent the known upper limit of 35 – 36 mm for the category in which flange was formed and almost immediately lost again when the stress shell was detached. In rare instances such as these two specimens a remnant of the flange survives to indicate beyond doubt that flange development occurred. The Finke specimen is also exceptional in its degree of preservation, having a shallow obtuse ridge upon the anterior surface marking a line of parting of the stress shell (Cleverly 1987).

Complementary to the preceding specimen is a teardrop-indicator II having only a short length of the butt of the flange (Fig. 5 G1 – G3). The styles of the two specimens are very similar. It is likely that the teardrop was in the same size category, but reconstruction of the parent body is not possible with confidence. Obtuse ridges are present on the anterior surface of this specimen also.

Acknowledgments

I thank Ms J. M. Scrymgour for information on the acquisition and provenance of the Finke Collection and Dr Brian Mason for specific gravity data on the Lake Torrens–Lake Eyre australites. Ms J. M. Wearne drafted Figures 1–4. Mr M. K. Quartermaine processed my photographs used in Figure 5.

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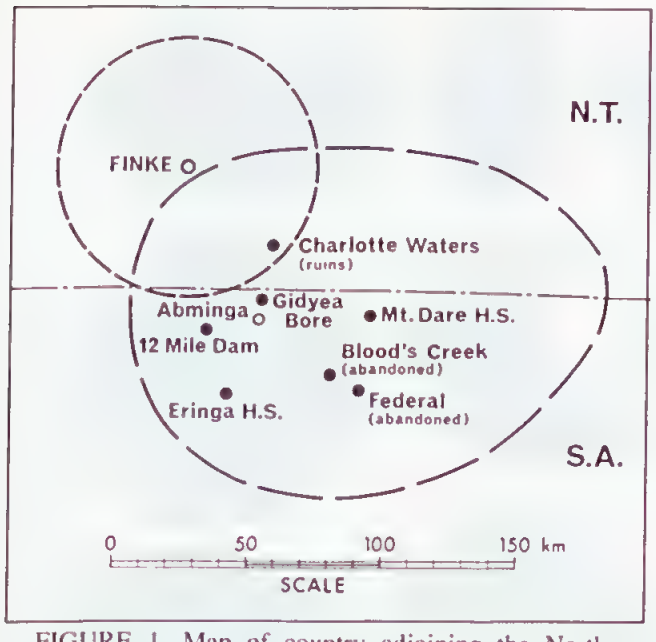

FIGURE 1. Map of country adjoining the Northern Territory/South Australian border showing provenances of the Finke and Kennett australite collections. Finke and Abminga (open circles) were stations on the now abandoned Central Australian Railway.

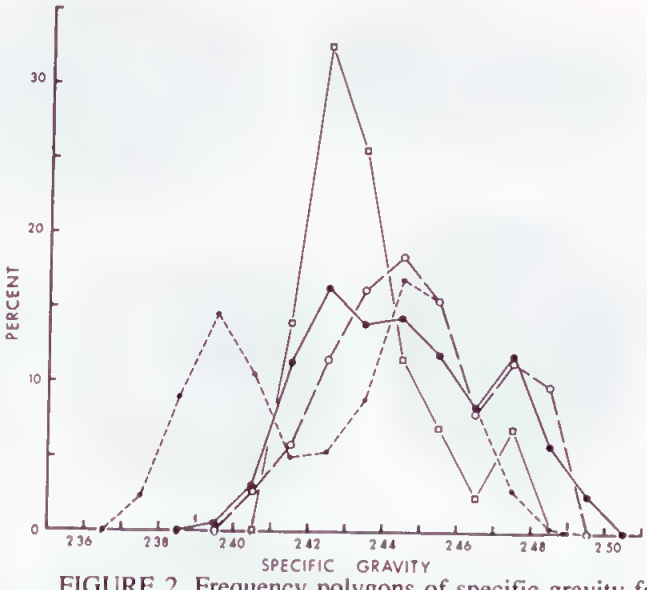

FIGURE 2. Frequency polygons of specific gravity for australites. Filled circles – sample of 202 from vicinity of Finke. Open circles – 420 from Charlotte Waters region (from Chapman *et al.* 1964 Fig. 7). Dots – 761 from Lake Torrens – Lake Eyre region (adapted from Chalmers *et al.* 1976 Fig. 15). Open squares – 46 specimens each weighing more than 11 g from vicinity of Finke.

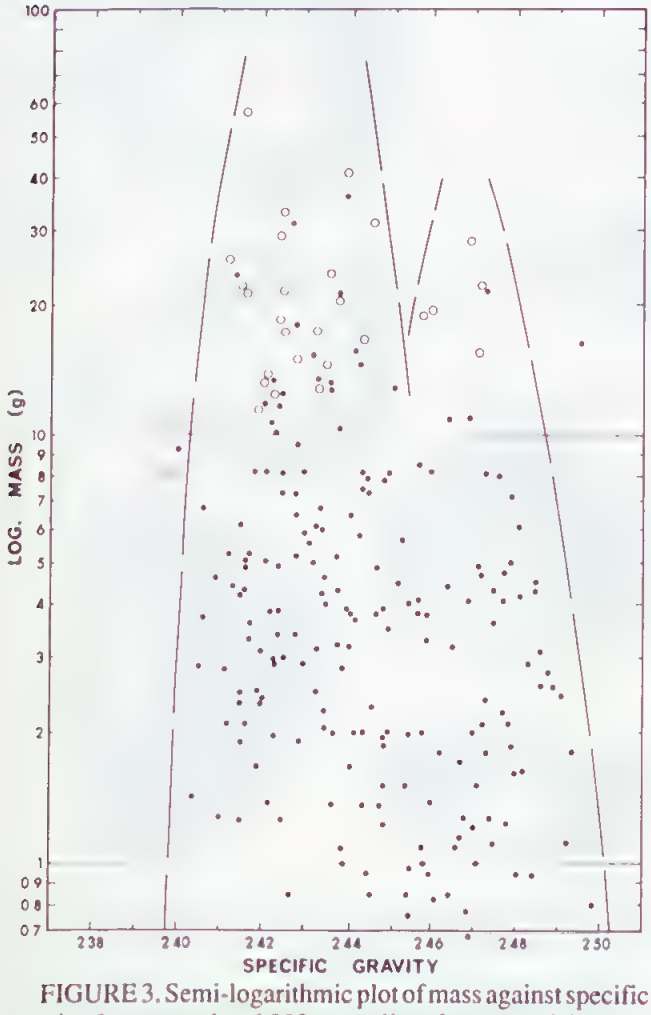

FIGURE 3. Semi-logarithmic plot of mass against specific gravity for a sample of 202 australites from the vicinity of Finke less five points in the lower mass range closely coincident with others. The open circles represent 27 additional specimens weighing more than 11 g each which are not part of the random sample. The broken lines are an interpretation of the distribution.

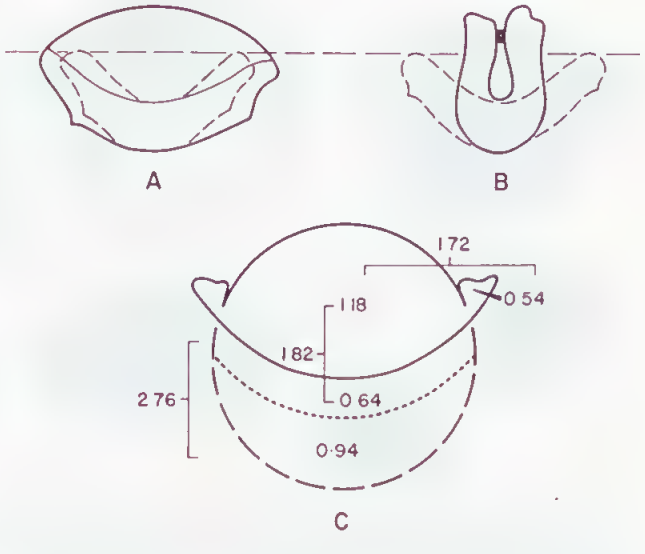

FIGURE 4. A. Side view of folded bowl T1346 with restored cross-sectional shape of bowl (broken line) within it. B. End view of folded bowl T1346 and restored pre-folding shape (broken line). C. Cross-section of button T1311 with restoration of spherical primary body (broken line) and profile of anterior surface when flange-building commenced (dotted line). Figures are volumes of various parts in cubic centimetres.

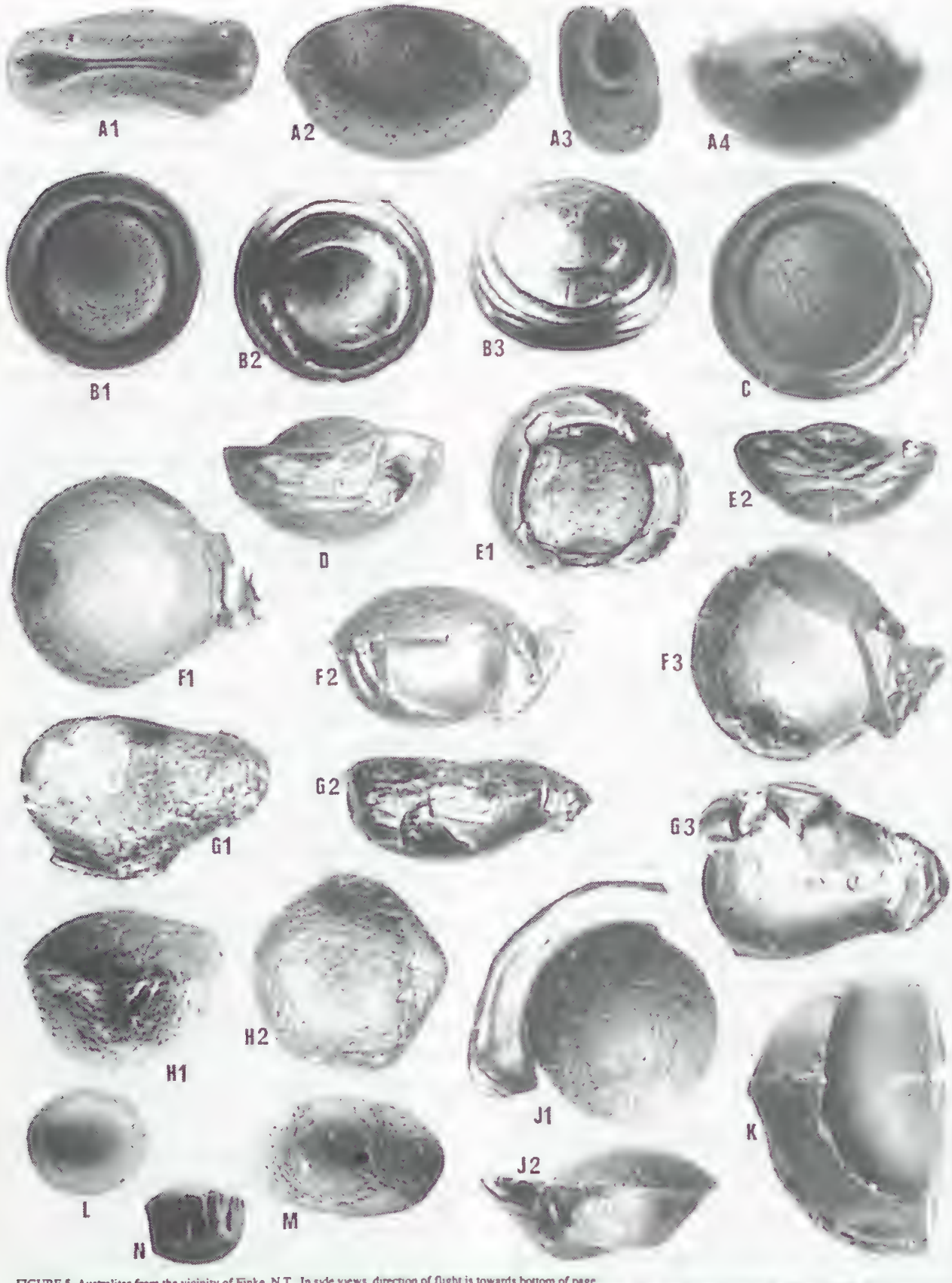

FIGURE 5. Australites from the vicinity of Finke, N.T. In side views, direction of flight is towards bottom of page.

A. Folded round or slightly oval bowl, T1346, 11.5 mm long. A1. Posterior view. The narrow pale streak along the middle is the fused union between the sides. A2. Side view (lower side of A1). A3. End view (right-hand end of A1). A4. Same side view as A2 but in transmitted light. Narrow elliptical area near 'lips' is the area of fused contact.

B. Button, T1311, 20.5 mm. diameter. B1. Posterior view. B2. View slightly oblique to anterior surface showing left-handed helical flow ridge. B3. View very oblique to anterior surface showing some of the radial secondary schlieren.

C. Button, T1314, 25.6 – 24.7 mm diameter, posterior view.

D. Button, T1309, 21.8 mm diameter, side view showing roll in flange towards upper right and torn hole below it.

E. Button, T1309, 20.2 mm wide. E1. Posterior view showing lack of flange at one side. E.2. Side view looking into the flange gap and showing continuity of flow ridges around the gap.

F. Round indicator I, T1375, 35.6 mm across. F1. Posterior view showing small flange remnant at right. F2. Side view with remnant of flange and stress shell at right. F3. Front view showing complex flow ridges on remnant of stress shell.

G. Teardrop-indicator II, T1375, 39.4 mm long. G1. Posterior view showing remnants of stress shell around narrow end and below, latter with short length of butt of flange. G2. Side view showing flow ridges on stress shell. G3. Front view with flow ridges on stress shell above and at right.

H. 'Tailed' or 'beaked' core, T1389, 35.5 mm across. H1. Side view. H2. View somewhat oblique to front surface to emphasize the 'beak'.

J. Round indicator I, T1315, 23.7 mm wide. J1. Rear view showing large remnant of flange. J2. Side view.

K. Fragment of hollow core, T1402, 36.5 mm high.

L. Broad oval core, T1389, 24.6 mm long, rear view showing flow swirl.

M. Narrow oval core, T1389, 35.5 mm long, rear view.

N. 'Small' round core, T1389, 17.5 mm diameter, side view.

TABLE 1. Morphological classification and masses of australites from vicinity of Finke, N.T.

Shape type	Number of specimens			Masses of complete specimens, g		
	Complete	Broken	Total	Lightest	Heaviest	Mean
Button	9	11	20	2.90	7.85	4.78
Round Bowl	1	-	1	0.43	-	-
Round indicator I	68	21	89	0.97	21.33	3.28
Lens	262	173	435	0.39	4.60	1.78
Round indicator II	25	-	25	2.44	21.74	7.52
Round Core	199	44	243	1.21	31.40	5.80
Broad oval canoe	1	-	1	1.23	-	-
Broad ocal indicator I	2	-	2	3.22	3.60	3.41
Broad oval lens	24	11	35	0.78	4.30	1.99
Broad oval indicator II	5	-	5	3.67	10.14	6.06
Broad oval core	43	14	57	1.29	57.50	8.56
Narrow oval plate	-	1	1	-	-	-
Narrow oval canoe	1	3	4	5.93	-	-
Narrow oval indicator I	2	1	3	1.49	4.29	2.89
Narrow oval lens	34	30	64	0.69	6.29	2.53
Narrow oval indicator II	5	-	5	1.49	21.96	7.78
Narrow oval core	27	15	42	3.21	18.92	8.30
Boat-canoe	1	1	2	0.83	-	-
Boat-indicator I	2	-	2	2.65	4.48	3.56
Boat-lens	11	9	20	1.00	7.14	3.10
Boat-core	16	6	22	4.80	28.20	12.48
Dumbbell-indicator I	1	1	2	4.33	-	-
Dumbbell-lens	11	12	23	1.02	5.82	3.05
Dumbbell-indicator II	1	-	1	6.56	-	-
Dumbbell-core	13	15	28	2.24	14.47	8.31
Teardrop-lens	5	3	8	1.37	4.98	2.66
Teardrop-indicator II	1	-	1	15.58	-	-
Teardrop-core	1	-	1	2.76	-	-
Conical core	37	4	41	0.93	6.05	2.98
Aberrant	3	3	6	0.62	5.84	3.27
	811	378	1189		Mean	4.24
Fragments			583			
Flakes and flaked cores*			39			
			1811			

* 'Core' as used by the anthropologist.

TABLE 2. Comparison between australites from the vicinity of Finke, N.T., and Edjudina Station, W.A.

	Finke N.T.	Edjudina Station, W.A.
Complete or essentially so %	44.8	43.8
Incomplete but classifiable %	20.9	9.7
Total classifiable %	65.7	53.5
Fragments %	32.2	43.0
Flakes and flaked cores %	2.1	3.5
Round forms %	71.8	70.3
Broad oval forms %	8.8	7.2
Narrow oval forms %	10.1	9.2
Boat forms %	3.9	4.1
Dumbbell forms %	4.6	7.1
Teardrop forms %	0.8	2.1
Flanged, disc, plate, bowl and canoe forms %	2.5	0.4
Indicators I %	8.3	1.4
Lens forms %	49.4	65.1
Indicators II %	3.1	1.0
Cores %	36.7	32.1
Cores/lens forms	0.74	0.49
Number of complete australites	811	824
Mean mass of above (g)	4.24	2.40
Total number of specimens	1811	1883
Mean mass of all specimens (g)	3.37	1.94

ISOBEL WHITE

WHITE, I. M. 1988. Fighting in an Aboriginal Community. *Rec. S. Aust. Mus.* **22** (1): 49–51 .

This brief paper describes fighting at Yalata, an aboriginal community in the far south-west of South Australia and compares this favourably with the uncontrolled aggression and violence in western society.

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Every newspaper today carries reports of deaths and grave injuries caused by terrorism, violence and aggression, covering a whole range of brutality, from the bashing of harmless old women, to bombing of buildings, to full-scale war. These reports come from the so-called civilised world of Europe, the Middle East and the Americas. Moreover a rash of violence has broken out on the sports field, even in Australia. All this has made me reconsider the instances of aggression and violence I witnessed in a remote Aboriginal community nearly twenty years ago. This shocked me at the time but more recently I have come to the conclusion that the Aboriginal anger and antagonism I witnessed were mild compared with what is in the news today, that the amount of bodily injury was strictly controlled and that after an episode of violence, aggression was quiescent for some time. Consciously or unconsciously Aborigines had so ordered their outbreaks of aggression and violence that death and injury were controlled and minimised. This is unlike what happens in the western world where perpetrators of violence, even in time of so-called peace, take little account of the amount of death and injury they cause, or whether their victims are those responsible for the original conflict.

Yalata is an Aboriginal community situated in mallee, western myall and melaleuca scrub on the coastal strip between the head of the Great Australian Bight and the Nullarbor Plain in the far west of South Australia.

The inhabitants are Western Desert people who first came south to the newly constructed railway line in the 1920s and 1930s. Most congregated during the 1930s and 1940s around the United Aboriginal Mission (U.A.M.) at Ooldea and were induced to move even further south in the early 1950s to Yalata Lutheran Mission after the U.A.M. withdrew quite suddenly from Ooldea (White 1985: 222–223). They were prevented from returning to their own territory during the period of nuclear weapons experiments at Maralinga and Woomera (Brady 1987). The new Yalata Aboriginal Reserve was outside their own territory and when I visited them they still felt displaced and landless (White 1985: 226); but they had become economically dependent on European–Australians (White 1985: 217–219).

At the same time they maintained their language (Pitjantjatjara and other Western Desert dialects) and much of their traditional culture, including some of their ceremonial life. Boys were initiated, though I was told that the rituals were abbreviated; for example, the period of seclusion only lasted a few weeks. While the initiation ceremonies still included the bestowal of a daughter by the circumciser, the promise was not always fulfilled, leading to some of the fighting described below. A rain ceremony was performed each year (White 1979). For my benefit the women performed a number of their secret ceremonies with great enthusiasm (White 1975: 132–133) but they were not teaching these to the girls in the old manner and they admitted they did not perform them in my absence. When I last paid a visit to Yalata in 1981 my friends told me that their last performance was the one I saw in 1973.

The descriptions of fighting in this paper are based on my experience during fieldwork at intervals between 1969 and 1973, each visit lasting between three weeks and two months.

I am not considering here the killings that occurred in this community following breaches of the laws against sacrilege. I know little of the events behind such deaths, which fall into quite a different category from the open brawling whose origin normally lay in disputes over marriages, betrothals and adultery, entirely secular matters. T.G.H. Strehlow (1970: 112–122) while describing punishment involving many deaths in Central Australia for sacrilege of various kinds, emphasises that these were quite different from personal quarrels arising from such matters as marital disputes. These personal quarrels would be settled by the persons involved with the help of their kin. Though some bodily injuries were tolerated killing should not occur, except that the Aranda punishment was death for incest between a man and his mother-in-law and for the seduction of the wife of an important ritual leader.

Before I first pitched my tent in the 'big camp',

about 15 km from the mission headquarters, the white mission staff at Yalata warned me that 'the Aborigines were always brawling' and that I would find these brawls noisy and alarming. I admit I was at first frightened when loud quarrelling broke out a week or two later. But I soon found that I was not in the least threatened and that I might as well observe what was happening. At this and later incidents I noted particularly that these conflicts followed a fairly regular pattern and that noise far outran action. Injuries were limited and seldom serious and when one or other of the protagonists was hurt the fighting normally ceased at once, though there might be some incidental quarrels and injuries in other parts of the camp. Similarly in these peripheral quarrels action stopped as soon as any injury occurred. Unfortunately some of the rules went by the board if the contestants were drunk, so that serious, sometimes fatal, injury resulted, though I did not witness such an event. Moreover when there were drunken people about there might be danger involved to non-participants. Care was always taken to keep out of the way of such irresponsible individuals. On one such occasion the adult women of 'my family', including myself, picked up toddlers and babies in order to be ready to evacuate the family campsite.

These events seemed to me equivalent to a weekly visit to the movies or to a sporting fixture in our society, and certainly less dangerous than some sporting events have become. Just as the amount of alcohol available increases the danger at football and cricket matches, so the danger increased with the amount of alcohol available in the camp, where there were no police present to attempt control and perhaps to become the target of all spectators. To an outsider, life in the camp at an Aboriginal settlement may seem rather dull for the inhabitants and these fights certainly livened up the daily round and were a matter for excited discussion for many days afterwards.

The standard order of events was as follows: loud shouting would be heard from one part of the camp and most of the inhabitants would rush to the scene as supporters of the contestants or as observers. Usually those supporters who felt themselves involved in the dispute would take off their clothes, the main combatants having already done so. For example, when an old couple near me heard the raised voices of their daughter and son-in-law they immediately hurried towards the contest taking off their clothes and throwing them aside as they ran. Each adult man would pick up his spears and spearthrower in his left hand and his fighting boomerang in his right, more as a gesture of strength and alertness than with any intent to use them immediately.

It seems there were rules about the choice of weapons. Sometimes the protagonists would have spears and spearthrowers or perhaps knives but when I witnessed a quarrel between two brothers (same father, different mothers) they had no weapons at all but merely wrestled. Where spears, or knives, were used, skill was needed so that the wound was in the fleshy part of the thigh and did not cause too much bleeding. For such an injury men did not always go to the mission nurse. They were proud of their scars, which would have been less obvious if skilfully stitched. The only wound of this kind I actually saw at close quarters (I drove the injured woman to the mission for treatment) was in the thigh of the daughter mentioned above, inflicted with a knife by her disappointed lover when he realised she was returning to her much older husband. Her wound was deep and painful but not dangerous. This particular dispute broke out into violence or near violence at intervals over several days. Some hours after this knifing, there was another hour of shouting and abuse between the lover and members of the woman's kin and affines. Then the 'big men' of the camp moved in on him with their weapons at the ready (as I describe later) but instead of obeying them and ceasing to threaten violence he produced a rifle and threatened them. By now it was very late at night and all retired to their own camps, but in the morning the tables were turned on the young man when two policemen arrived from Ceduna and arrested him. I was told that the camp leaders had taken the unusual step of asking the mission superintendent to send for the police, because the young man had behaved in a way they could not counter, in producing a rifle. Moreover this was not the first time he had seduced a woman of their community; a year before he had eloped with a much younger unmarried girl and had managed to travel on a train to Kalgoorlie with her, before her male kin caught up with them and managed to bring her back.

The above account represents an unusual series of events and I now return to the more normal processes of a camp fight. When fighting first broke out it was interesting to observe the behaviour of the children. Clearly they knew they must not join in the ring of observers, either because of instruction from their parents, or because they were too frightened by the noise of quarrelling. I am not sure at what age they could join in, I only knew that when I observed these scenes all children between the ages of about five and fifteen immediately gathered in small groups and retired to the outer periphery of the camp where they lit their own small fires and stayed until the noise and shouting died down. In the meantime, as I have already described, the adult women stayed close by babies and toddlers, ready to pick them up if they felt there might be danger.

Margaret Bain, who has lived for many years with Pitjantjatjara speaking communities, told me that by carrying a child, a man or a woman signalled that he or she was not involved in the quarrel. I have never heard of a child being injured in these brawls, certainly not by intention, and not by accident because of measures taken by both adults and children.

While the original contestants were shouting at each other and preparing for action, subsidiary quarrels would be disinterred so that it soon sounded as though everyone was shouting loudly. This made the dogs bark and howl frantically and the noise was quite deafening. (I made a tape-recording of one such episode.) The original dispute was likely to concern, immediately or marginally, a proportion of the inhabitants. Here is an example: the two brothers who wrestled together were fighting over a woman. Meanwhile their old blind father was begging them to desist, claiming it was not proper for brother to fight brother. The older of the two brothers had been deprived of his promised wife some years before because the girl was supported by her mother in her preference for another man. (For this the mother had been speared by the disappointed young man.) Now the mother of the younger brother resurrected the dispute and loudly accused the mother of the girl of causing the present fight, because her son would not now have been fighting his brother about a woman if that girl had been given to her proper husband in the first place. I knew both these two older women well; they had cooperated in the performance of women's ceremonies and I had not suspected that the old dispute was still an issue between them.

The main fight was the pretext for many other old conflicts to be revived and for old disagreements to be aired very loudly. There was even a resurgence of rivalry between the two dominant groups in the camp, the Pitjantjatjara and the Yankuntjatjara, normally almost indistinguishable after two or three generations of living together and intermarrying; now each accused the other of horrible customs. Another reason for further quarrels to break out in various parts of the camp was that some of the shouting consisted of sexual boasting by one of the men, whom I had recognised as a local Don Juan. Since these boastings were likely to involve married women within hearing, several new quarrels would break out between these and their husbands, or between the husbands and the boaster. In the end it seemed that half the people were shouting abuse at the other half, at the tops of their voices.

This would go on for an hour or two, by which time there would be a small number of minor injuries. One or other of the original protagonists might have been hurt so that that particular fight would have ceased. But by now everyone would be tired and mothers would complain that their children should be allowed to sleep. Eventually the senior men, the 'big men' of the community, would intervene. Each in turn would put brushwood on his fire so that it would send flames several feet into the air and he would stand in front of it for all to see. He would first proclaim on the rights and wrongs of the main quarrel. He would then say something to the effect that the young men must stop fighting now, they had had their chance to settle their disturbances, they had caused a lot of noise and disturbance but now everyone had had enough and it was time to stop. In turn several of these older men would repeat this performance. With their weapons in their hands they would then move in a circle against those still fighting, thus showing the power of the leaders against the younger men. Quickly the noise would cease, people returned to their own camps and soon all would be asleep.

In the morning there might be a few with headaches or in pain from injury, but there would be peace in the camp and the contestants from the previous night would seem to have resolved their quarrels. Certainly all the furore had had a cathartic effect. It had been salutary to have had all the dissension out in the open and for once to tell one's neighbours exactly what one thought of them. All the evil remarks and accusations seemed to have been forgotten, though they might be a pretext for a later conflict. Aggression was limited to a few hours at intervals of some weeks. Occasionally, in the middle of the night, the silence would be broken by a man voicing his grievances and shouting abuse at some other person. The rest of the time in my observation these Western Desert people behaved in a quiet, restrained and dignified manner. Conversations were carried on in low voices and shouting was seldom heard. Even against misbehaving children voices were not raised. The chief noise in the camp was of dogs barking rather than of human voices.

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E. WILLIAMS

WILLIAMS, E. 1988. The archaeology of the Cooper Basin: report on fieldwork. *Rec. S. Aust. Mus.* **22** (1): 53–62.

This paper presents the results of the first season of fieldwork of an archaeological study of the Cooper Basin near Innamincka, South Australia.

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Australia is a dry continent — 60% of its land surface is covered in arid vegetation while a further 22% is covered in semi-arid species (Williams 1979, V.I. Fig. 1). In the past at the height of the last glaciation, an even greater proportion of the continent lay within the arid zone (Bowler 1982). Yet until recently, little archaeological research was carried out in arid Australia, despite the importance of the region to questions about the colonisation of the continent. The work which has been carried out suggests that a number of areas within what is now the arid zone, were occupied during the Pleistocene. Dates of 20 000 years BP and older come from sites in the Hamersley Plateau, north-western W.A. (Maynard 1980, Brown 1987); the Cleland Hills, central western N.T. (Smith 1987); Koonalda Cave, southern S.A. (Wright 1971); and Lake Yantara, north-western N.S.W. (Dury & Langford-Smith 1970). Whilst these sites show that much of the drier part of the continent was utilized during the Pleistocene, it appears that the most intensive occupation took place during the mid to late Holocene (Gould 1977; Hughes & Lampert 1980; Lampert 1985; Smith 1983, 1987).

Although much archaeological work has been undertaken recently in many parts of the arid zone, little was known about the archaeology of one area, the dunefields of north-eastern South Australia. This project was initiated to expand our knowledge of the region. The area chosen for study is that section of the Cooper Basin near Innamincka, South Australia (Fig. 1). It comprises a number of features — the main Cooper channel, an ancillary channel — the North-west Branch, and an extensive series of clay-pan lakes in the Cooper flood-out zone lying within the Strzelecki dunefield. These lakes are the only ones which regularly fill with water for thousands of square kilometres. My particular focus is the lakes, since little is known about either the prehistoric occupation or the environmental history of these features.

There are a number of reasons why this project can tell us more about the occupation of arid Australia. The first is that while the region is an extremely arid one — it receives one of the lowest rainfall readings of any in Australia (125 mm per annum) and is mostly covered by a large dunefield, the Strzelecki, there are reliable water resources there. This made the area an important one for Aboriginal settlement, at least in the recent past (Sturt 1849). The Cooper drains the Channel Country of central Queensland and every year the wet season rains come down the river, filling a succession of deep waterholes on the Cooper at Innamincka and then the Coongie lakes, 100 km to the north-west. The large waterholes on the Cooper and its overflow channel, the North-west Branch are permanent, while the lakes hold water from between five months to most of the year, depending on their location relative to the channel. While the abundant (albeit seasonal) water resources make this area atypical when compared to many parts of the arid zone, this region can tell us much about how people in the past dealt with fluctuations in water availability. This is because although there are large, reliable waterholes near Innamincka, there are few permanent water resources in the surrounding region. Early explorers such as Sturt (1849) and Burke & Wills (1861) always retreated back to this stretch of the Cooper because of a lack of reliable water anywhere else — upstream or downstream.

Even the upper reaches of the river contain very little standing water, much less than around Innamincka and the channel does not always flow (Gregory & Gregory 1884: 205–206, Jones 1979). In order to reach the lakes and permanent waterholes, the initial colonisers would have had to push through extremely arid areas and would have thus needed to develop a flexible economic system which could deal with these variations in water availability. Such hydrological fluctuations have characterised the Cooper drainage basin for at least the last 20 000 years. It was probably only prior to 30 000 yBP that there were abundant water resources throughout the region.

The second reason why this area was chosen for study concerns the probability of finding Pleistocene archaeological material there. Wasson's work on the sedimentary and climatic history of the dunefields, which is described later, has shown that exposures of

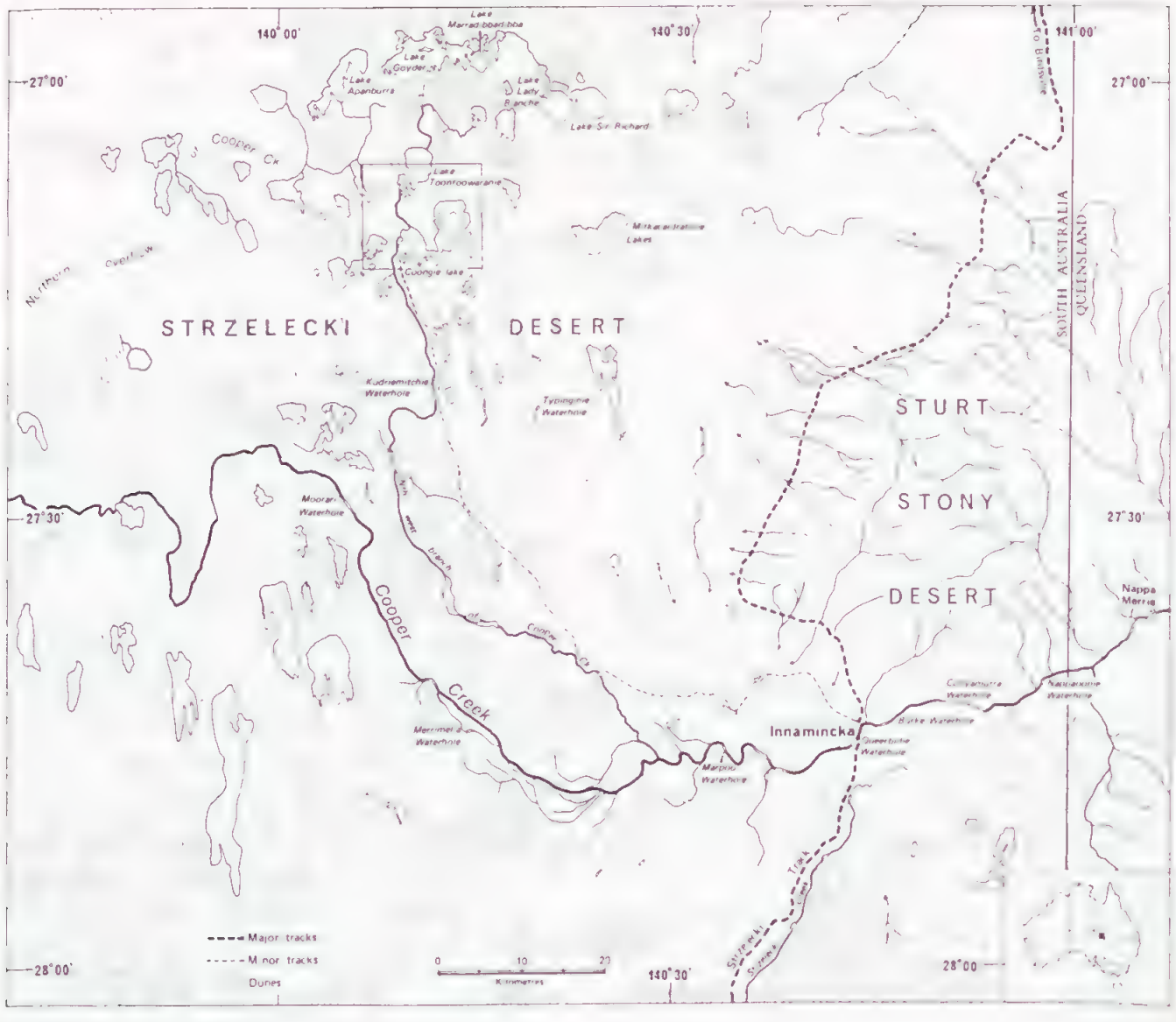

FIGURE 1. Locality map.

Pleistocene sediments are common in these landforms and the region is thus a promising one in which to look for early sites. As well, his work provides a valuable framework in which to place work on the history of Aboriginal occupation.

The major aim of the project is to obtain baseline archaeological data for the region and if possible, determine whether it was first settled during the Pleistocene. The question of the Pleistocene occupation of the arid zone is a contentious one. Bowdler (1977) believes that aridity was a major problem in the colonisation of Australia. She claims that the first settlement of the arid zone occurred quite late — around 12 000 yBP, after people had first colonised the coastline and then the major river systems. She believes that once the coastline was settled, people then moved up the major river systems taking with them a specialised 'coastal' economy, expressed as a dependence on fish, shellfish and small mammals. She suggests that the move away from the major river systems and the development of a non-aquatic adaptation or 'desert' economy only appears quite late, after about 12 000 yBP and involves a shift from aquatic foods to the wide-scale and specialized exploitation of grass-seed and a dependence on larger mammals, especially macropods. It appears, however, that recent work in the Northern Territory refutes this model. An excavation of Puritjarra rockshelter in the Cleland Hills, has revealed an archaeological sequence extending back 22 000 years (Smith 1987). This site is located in an extremely arid area, well away from major drainage systems, in a region which would have also been very dry throughout the late Pleistocene. Smith's work shows, therefore, that people were living in the core arid zone well before that predicted by Bowdler's model. Other research by Smith refutes further aspects of the model. His work on grindstone morphology shows, for example, that the intensive exploitation of seed plants did not take place until the late Holocence, which is much later than Bowdler predicted. This

adaptation could therefore not have triggered the initial colonisation of arid areas (Smith 1986).

Smith's data suggest that people had pushed into the arid core of the continent by at least 22 000 yBP. It appears these early colonists had a fairly generalised economy, lacking for example a specialised seed-grinding technology. While the development of the more detailed model awaits further publication of Smith's work, one aim of my project will be to look at the issue of Pleistocene occupation as regards north-eastern South Australia. Is there evidence for Pleistocene occupation here and if so, what type of economy did the early colonists possess?

As well as this interest in Pleistocene occupation I have a number of other aims. The first is to determine when the most intensive period of occupation took place — was it during the mid to late Holocene period, as other work to the south, and in other regions has shown (Hughes & Lampert 1980; Lampert 1985; Lampert & Hughes 1987; Smith 1983, 1987)? Secondly, the information on prehistoric sites will be ultimately used to form a number of management proposals to protect the archaeological material from a number of threats including oil and gas exploration, pastoralism and tourism. Here I will be working closely with the Aboriginal Heritage Branch of the South Australian Department Australian of Environment and Planning.

The project is funded for three years and this paper reports on the results of this, the first field season. Given the preliminary nature of the work, my data and conclusions will be fairly general. Before describing the results of the fieldwork, I will first provide an environmental context for the research by presenting below information on the geography of the region and then on climatic change.

Environmental Setting

The region has a hot, dry, desert climate with short, cool to cold winters. Rainfall is extremely low (125 mm per annum) and unreliable, while mean annual evaporation is very high (3800 mm per annum). There is no distinct seasonal pattern to the rainfall distribution.

Within the region there are two distinct land-systems (Laut *et al.* 1977, Hughes & Lampert 1980). These are briefly described here, because as I will outline later, the nature of the archaeological material varies with land-system.

i. Merninie Environmental Association

This land-system lies in the eastern part of the study area to the east of the Birdsville track (Fig. 1). It consists of a gently undulating stony plain with low silcrete-capped rises. Here the Cooper is confined within a narrow floodplain and comprises a series of permanent waterholes each up to several kilometres long. East-west trending dunes have formed along the margins of both banks of the river and Hughes (Hughes & Lampert 1980) notes that they broadly resemble those of the Cooper flood-out zone to the west (see below). The vegetation in this land-system consists of occasional stands of mulga (*Acacia aneura*) and a sparse low shrubland of native fuchsia (*Eremophila* spp.) and dead finish (*Acacia tetragonophylla*) over tufted grasses such as saltbush (*Atriplex* spp.) and Mitchell grass (*Astrebla pectinata*). The Cooper channel and floodplain is fringed by woodlands of river red gum (*E. camaldulensis*), coolibah (E. *microtheca*) and coolibah box (*E. intertexta*).

Stony land-systems which have similar landforms and vegetation are also found in this general region and lie to the north-west, north and north-east of the study area. They are virtually identical to the Merninie landsystem and are therefore not described here. More information on them can be obtained from Laut *et al.* (1977).

ii. Cooper Creek Environmental Association

This land-system covers most of the study area, lying to the west and north-west of Innamincka. It comprises the Cooper flood-out zone and consists of a field of parallel dunes and interconnected claypans periodically flooded by Coopers Creek. A number of the larger claypans form lakes. Some of these, for example the Coongie Lakes system (Fig. 1) are filled annually by freshes of water which come down the Cooper from the Channel Country of northern and western Queensland. These lakes fill from an overflow channel of the Cooper, the North West Branch, but only one or two lakes hold water for more than six months of the year. Other lakes and claypans are filled either with the Cooper flood-out, or by prolonged local precipitation.

The dunefield consists mostly of longitudinal dunes which trend north-south. Transverse dunes are found on the northern (downwind) sides of floodflats (Twidale 1972, Wasson 1983). Both types of dunes are rich in clay with the clay occurring in sand-size aggregrates or 'pellets'. The vegetation on the dunes and around the lakes is variable, ranging from samphire (*Arthrocnemum* spp.) and chenopod shrublands of old man saltbush to lignum (*Muehlenbeckia cunninghamii)* and canegrass (*Eragrostis australasica*). The floodplains and channels of the major river systems are fringed by the same tree species as noted for the previous land-system i.e. river red gum, coolibah and coolibah box.

The region has not always been environmentally stable and over time there have been significant changes in the climate and landforms. Given the scale of these changes, they would have undoubtedly affected human occupation, and are therefore outlined here.

Environmental History

The clay-rich linear and transverse dunes have been studied by Wasson and preserve a sediment record of climatic change in the region (Bowler & Wasson 1984; Gardner *et al.* 1987; Wasson 1984, 1986). The presence of clay pellets suggests that the dunes were formed when muds and fine sands deposited by the Cooper were deflated from salinized swales. The floodplain sediment was derived from alluvium deposited directly by the Cooper or, where areas were cut off from a direct supply of flood sediment, from saline groundwater-controlled deflation. The pelletization of the clays requires the salinisation of sediments and this occurs in a regime of fluctuating saline groundwater. As well as this mode of formation there is now recent evidence which suggests that clay pellet formation can occur without salts as long as there is a supply of fresh alluvium (Gardener *et al.* 1987).

The dunes contain four main stratigraphic units. The uppermost is a modern mobile aeolian sand, mostly quartzose with rounded clay pellets. Below this is a unit which also comprises quartzose sand and clay pellets and is late Holocene in age. The next unit has a similar composition of quartzose sand and clay pellets and as well has some carbonate formation and was deposited between 13 000 and 23 000 yBP. The lowermost unit also contains quartzose sand and clay pellets but is also slightly reddened and has pronounced carbonate formation. Thermoluminescence dating of this unit suggests it may have been deposited as long ago as 240 000 yBP (Gardner *et al.* 1987). Analysis of these sediments and of other features in the regions and in other areas gives the following environmental sequence beginning with the late Pleistocene (Bowler & Wasson 1983; Wasson 1994, 1986).

About 50 000 years ago lakes in the southern half of Australia were noticeably expanded. At this time also the Cooper was depositing predominantly sandy alluvium in contrast to the muds and silts it deposits today. This suggests the river was discharging water at an increased velocity relative to the present and could indicate a greater discharge overall. If this was the case then it is probable that the lakes in the study area, like those in southern Australia, were also noticeably larger.

The lakes in southern Australia remained full for some time although after about 30 000 yBP there was some oscillation in lake levels. This lasted until around 22 000 yBP when the lakes began to dry up. About this time too, the Cooper ceased depositing predominantly sandy alluvium and began depositing a mixture of sand, silt and clay, indicating a decrease in stream velocity. The presence of the clays in the floodplain sediment initiated the period of clay pellet formation in the swales between the dunes. During this time a major phase of dune building began and continued until the terminal Pleistocene. The most intensive periods of sediment mobilistion took place between 16 000 and 20 000 yBP at the height of the last glaciation. Dune building was triggered by a combination of factors: an increase in wind speed, radiant summer energy and pressure gradients, and a decrease in humidity. These also induced a lowering of the water table, increasing the salinization of the clay-rich floodplain sediments.

At around 12 500 yBP there was another significant climatic shift in the region when frequent flooding of the outer areas of the Cooper floodplain ceased. This removed most of the sediment available for dune building and the dunes ceased accumulating sediment. Dune building began again in the late Holocene, although on a smaller scale than in the late Pleistocene. This event mostly involved a reworking of older dune units and there does not seem to have been a return to the climatic conditions of the last glaciation. Wasson believes that this mobilisation of sediment is linked to shifts in climate, reflected by falling lake levels in eastern Australia. He also outlines the possibility that it may be related to a more intensive occupation of the region by Aboriginal groups through the firing of vegetation for example, but notes that there is insufficient evidence to look at this hypothesis at present (Wasson 1986).

The data presented above show that the region has undergone significant climatic change in the last 50 000 years. This has undoubtedly affected Aboriginal occupation of the area and I will be focusing on this issue by looking at the occupation history of the lake systems. As I will show below (by citing historical accounts of Aborigines), the lakes were an important focus for settlement. An analysis of the archaeology of these areas can not only provide information on prehistoric occupation but, as well, data on climatic change, through the study of the sedimentary history of dunes associated with the lakes. As well, information derived from the latter work can be compared with Wasson's chronology derived from his work on the dunefield.

Before presenting the results of the survey work, I will first put the data within an ethnographic context, by briefly summarizing the historical accounts of Aboriginal subsistence and settlement patterns for the region.

Historical Accounts of Aboriginal Subsistence and Settlement

Historical records show that the Cooper and its associated lakes were the main focus of settlement in the region (Sturt 1849, Burke & Wills 1861, McKinlay 1862). These areas were densely populated. Sturt saw a camp of between 300 to 400 people about 50 km east of Nappa Merrie station in Queensland (1849: II, 75–79). North of Innamincka, around the Coongie lakes, McKinlay saw over 300 people at Hamilton Creek, 200–300 people along the North West Branch of the Cooper just south of Coongie and at least 150

people around the Lake Lady Blanche (1862: 37, 38, 46). Most groups, however, were smaller than these large aggregations. Camps of between 20 and 40 people were common and some settlements seemed to have been occupied on a semi-permanent basis (Sturt 1849, Burke & Wills 1861, McKinlay 1862). Huts at these camps were substantial domed structures (Horne & Aiston 1924).

The main food consumed in the vicinity of the lakes and river country was fish and mussels, water birds and nardoo (*Marsilea* spp.), a small clover-type plant that grows on floodflats. The sandhill country was also utilized, and as Jones (1979) has shown, was more productive than the lakes and rivers as regards food plants and small mammals. Staples obtained from the dune fields comprised a wide variety of seed plants, especially native millet (*Panicum decompisium*) and 'Munyeroo' (*Portulaca* spp.), and roots and tubers, especially 'yams' (probably *Impomoea* sp.) (Jones 1979, Kerwin & Breen 1981). Snakes, other reptiles, and many species of small mammals were used as food resources.

Jones (1979) has studied the historical material and has developed a model of subsistence and settlement patterns which is supported by the available historical evidence. He shows that while people mostly lived close to the major water sources, after rain, groups pushed out into the dunefields to exploit the plant foods which had germinated and to obtain the grubs, reptiles and small mammals which were abundant here. As the surface water in claypans between the dunes began to dry up, people moved back on to the creeks, rivers and lakes to harvest the plants such as *Panicum* and nardoo now ripening on the floodplain. As well as this pattern of seasonal movement, Jones observes that some groups remained on the lakes and river throughout the year. In these areas there were sufficient resources to support semi-permanent settlement (e.g. King in Burke & Wills 1861). Jones also found that the stony country contained significantly fewer food resources than other land-systems and was not a favoured area for settlement (e.g. Sturt 1849: II, 43).

From this brief overview of the historical material we can hypothesize that the largest sites will be found in areas which have permanent or semi-permanent water sources. Surface campsite material will be found in the dunefields but sites will be smaller than those on the margins of lakes and permanent waterholes.

These ideas, along with those concerning Pleistocene occupation, are discussed in the light of field data in the following section. The results of previous work in the region are discussed first.

Previous Archaeological Research in the Area

The previous work in the region has comprised short-term studies of small areas as part of environmental consultancy projects (Hiscock 1984, Hughes 1983, Lance & Hughes 1983) and 'reconnaissance' trips to appraise the archaeological potential of a region (Hughes & Lampert 1980, Lampert 1985). Almost all surveys were restricted to the region south of my study area, to the dunes and the main Cooper channel and little work was carried out on the lake. Although none of this work has involved long-term studies and it did not look at the lake systems, sufficient surveys have been done to isolate some trends in site type and distribution. These are outlined below.

The survey found that sites are common in the region and that site type varies with land-system and environmental context. Quarries, stone arrangements and engraving sites are restricted to the stony country i.e. the Merninie land-system. General artefact scatters, shell middens and burial sites are found in both the stony country and the Cooper flood-out zone, but shell middens are restricted to the margins of lakes and permanent waterholes of the main stream and river channels. General artefact scatters were found to be the most common site type in the region.

As regards the age of sites, it was found that most sites dated (on typological grounds) to the mid to late Holocene. Pleistocene sites are extremely rare, at least in the dunefield and around the main Cooper channel. The only Pleistocene site found is an Aboriginal hearth, site 'JSN' dated by Wasson (1983). The hearth lies in the middle of the dunefield, about 270 km south-west of Innamincka and 90 km west of Strzelecki creek. Two dates have been obtained — 13 850 ± 190 yBP (ANU 2278) and 13 150 ± 830 yBP (ANU 2279). Because of the rarity of Pleistocene sites in the region, Lampert (1985) has hypothesized that the region was not settled on any permanent basis until the late Holocene and that any Pleistocene material found resulted from occasional trips made by the prehistoric inhabitants to the region from better watered areas to the south-west, such as the Flinders Ranges (see also Lampert & Hughes 1987).

Does this patterning of archaeological material also apply to the lake systems? In the following section I present my data for the lakes and conclude with a discussion on this issue in the light of my findings.

Field Work

Preliminary Work

The study area is very remote and there are logistic problems in running field work there. For this, my first field season, I concentrated therefore on a relatively accessible area — the lakes around and including Coongie. I began planning my field work by first examining colour aerial photographs of the region (Fig. 2). Using these I isolated features relevant to the archaeology of the area and these are discussed below.

The photos showed that some lakes (Coongie, Marroocoolcannie, Marroocutchanie and Toontoowarannie) fill on a regular basis while others (Apachirie and Mitkacaldratillie) do not. Although the last two lakes do not consistently hold water now, they do however have lake-shore features and thus regularly filled some time in the past. As well as this difference in water levels today, there is a distinction between these two groups of lakes in regard to a particular type of dune feature. On the lakes in the first group there is a pale coloured dune or series of dunes, trending north-west to south-east, which lies on the north-east margin of the flood-out zone of each lake. These features are absent on the last two lakes noted above. The dunes range in orientation from 15° to 30° west of north. They appear to be transverse dunes or Twidale's 'leeside mounds' (1972: 85–86) and are similar to the lunettes or clay dunes of semi-arid regions. Such features are formed when longshore drift transports debris to beaches or the lee shore of lakes. This sediment is then locally redistributed by the wind before being trapped by vegetation close to the lake margin. The reasons for their presence on lakes in the first but not the second group is unclear, but is possibly linked to higher water levels some time in the past. As well, there are a series of these dunes within the flood-out zone between Toontoowarannie

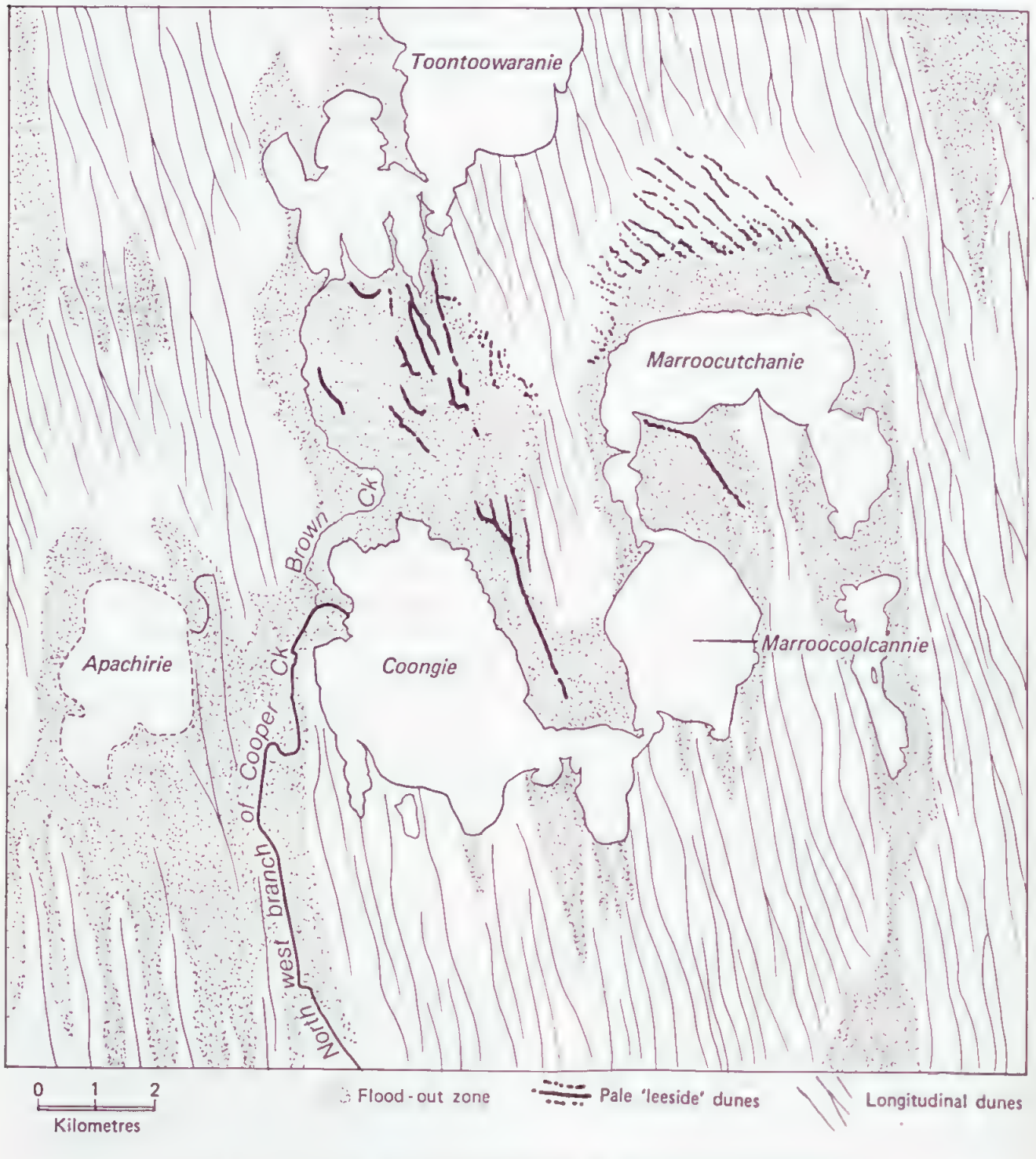

FIGURE 2. Part of the Coongie Lakes showing the pale-coloured 'leeside' dunes.

and Coongie. The mode of formation of these features is unclear because they are not directly associated with the lake shore as are the other dunes. A priority of the field work was to examine both types of dunes to determine how and when they were formed and whether they contain *in situ* Pleistocene archaeological material as do the lunettes of the Willandra and Darling lakes.

As well as looking at these pale dunes I examined exposures of Pleistocene sediments in the longitudinal dunefield, for *in situ* archaeological material. I also looked at sites generally around the lakes and creeks, to obtain information on site type and location.

The field surveys

In June and July 1986 I made two trips to the Cooper from a base in Broken Hill. The time spent in the field totalled five weeks. On both trips, work was curtailed because of heavy, unseasonal rainfall but despite this I managed to obtain data relevant to the issues outlined above.

During this field work I concentrated on getting an overview of the archaeology of the lakes. I surveyed sections of five lakes (Coongie, Marroocoolcannie, Marroocutchanie, Toontoowarannie and Goyder) and while I mainly concentrated on checking the pale dunes described earlier, I also looked at lake margins where there were no pale dunes and also at some parts of the main longitudinal dune field. General comments about site type and distribution are noted first, followed by a discussion of sites on the pale dunes.

In all areas surveyed I found that artefact density and site size increased as one approached permanent water sources. Site density was extremely low away from the lakes and major river channels. Because of the large number of artefact scatter sites seen, I did not record every site and instead only noted either very large sites or sites where I collected material for dating purposes. Record cards for these sites are held by the Aboriginal Heritage Branch, South Australia. Artefact scatters were the most common site type found and these comprised a scatter of artefacts exposed as a lag on dune blow-outs, where the more compacted Pleistocene sediment was exposed.

On many sites, freshwater mussel shell was associated with the artefact scatters, but this material was restricted to those areas where permanent or semi-permanent water was present i.e. the larger lakes and permanent waterholes on the channels. There was some variation in the quantity and distribution of shell relative to other archaeological material. I found, for example, that large midden sites, where shell is the dominant archaeological material, were restricted to areas where natural mussel beds were particularly abundant i.e. the margins of lakes close to inlet channels and the edges of large, permanent waterholes. Small scatters of shell, similar to Meehan's (1982) 'dinnertime camps' were scattered intermittently around the margins of the larger lakes and channels. Future work will look at these differences in distribution in more detail.

In virtually all cases the archaeological material was not *in situ* and had apparently deflated down from Holocene units. Typologically, most, if not all artefacts, dated to the mid to late Holocene. The main artefact types were tula adzes and adze slugs, small scrapers, cores, flakes and fragments of large, flat sandstone grindstones of the type described by Smith (1986). As well, largish, cube-shaped silcrete cobbles which were often ground on one or more surfaces were common. Cores and flakes were small in size and noticeably reduced and this is probably due to the fact that raw material sources lie some distance away (more than 50 km), in the stony country. Occasionally larger flakes and horse hoof cores were present. Favoured raw materials were silcrete, quartzite, chert and chalcedony. Hearth material, usually fragments of burnt termite mound, was often scattered across sites and occasionally fragmented human bone was also found. Isolated hearths were also present. Within the longitudinal dunefield proper, I saw only one site where material was not lying in the upper section of the late Holocene unit. This is Ellar Creek 1, which comprised a termite mound hearth *in situ*, lying near the base of the late Holocene unit. The hearth dates to 3080 ± 170 yBP (ANU 5428).

As noted earlier, sites increase in size and the density of material increased as sites became closer to permanent water. At Typinginie waterhole, for example, a permanent waterhole on an intermittent drainage line within the longitudinal dunefield, there was a higher density of material, especially termite mound heat retainers, than on sites in the dunefield generally. The largest sites in the study area were found on the margins of the lakes close to either inlet or outlet creeks and on the edge of large, permanent waterholes on the main watercourses. Especially large sites were found on the lakes near outlet creeks, towards the southern end of the lakes. Sites of this type include Lake Toontoowarannie sites 1 and 2, which comprise 7000 square metres and 10 000 square metres of shell midden respectively. The archaeological material on these two sites is similar to that outlined earlier and consisted of fragmented mussel shell, artefacts, scattered heat retainers and fragmented burials. As well, there were the remains of a collapsed 'gunyah' on the former site. Shells and artefacts on these sites lie either within late Holocene sedimentary units or are deflated down from Holocene units to lie as float on exposed Pleistocene sediments. A sample of shell from this site was submitted for dating and as expected, is late Holocene — 330± 80 yBP (ANU 5425). Such large and complex sites are not normally characteristic of arid areas and thus reflect the importance of the lakes to the region. Their presence is consistent with the high population densities observed by the early explorers.

Apart from these large sites, smaller scatters of artefacts, shells, hearth material and bone were found on the flanks of the longitudinal dunes along the margins of the lakes. These are larger than the sites found in the dunes away from the lakes. Examples of this type include Marroocoolcannie Sites 1 and 2. At the latter site there was also an area of burnt bone and shell. This material appears to be *in situ* and the bone, although not identified formally as yet, appears to be that of fish and small mammal species. This is consistent with the enthno-historical data outlined earlier which identifies fish and small mammals as important food sources. At both sites most of the material was again deflating from Holocene units onto Pleistocene deposits. At Site 1, mussel shell which is *in situ* dates to 1020 ± 80 yBP (ANU 5427) while at Site 2 a termite mound hearth dates to 1130 ± 110 yBP (ANU 5429).

As regards the pale-coloured dunes noted earlier, I surveyed exposures along the length of these dunes on Coongie, Marroolcoolcannie, Marroocutchanie, Marradibbadibba and in the floodplain between Toontoowarannie and Coongie. With the exception of a site at Marradibbadibba — Lake Goyder 1, I found that all archaeological material was deflating down from the upper, recent units. The sites were all similar and resembled the smaller lake-margin sites such as the Marroocoolcannie Sites 1 and 2 described above i.e. scatters containing artefacts, burnt termite mound and fragmented human bone. Shell midden material and large artefact scatters were scarce except for one large shell midden (Marrootcoochanie 1), on the north-west end of the Marroolcoolcannie dune, which in turn lies close to the inlet of Lake Marrootcoochanie. This is the only section of one of these white dunes which lies near the inlet channel of a lake. As well as general artefact scatters, a mounded burial (Browne Creek Burial Site) of the type described by Elkin (1937) was found in an area of pale dunes between Toontoowarannie and Coongie. The relative lack of material on these dunes, except for where they are close to inlet channels, reinforces the trends in site patterning noted earlier for the lakes generally. It suggests that source-bordering dunes in this area were not especially favoured for occupation as such. Future work will explore this proposition further.

The one site found within the lower part of one of the white dunes was Lake Goyder 1 and it lies within a white dune on the north-western margin of Lake Marradibbadibba. It is similar to the sites described earlier, with some exceptions. Heat retainer material is calcrete rather than termite mound and there is a burial and a small scoop hearth of burnt soil about 1 m across, lying within more consolidated sediments which are below what appears to be a recent unit. A sample of charcoal from the hearth is quite young, 810 ± 130 yBP (ANU 5424).

It is difficult to determine the significance of this date, given that it is much younger than expected. It is possible the sample was contaminated, possibly by recent floodwaters. Air photos reveal that this locality was submerged for some time during the 1974 floods. While I am unable to resolve this problem, there are other clues to the age and origin of the white dunes. Soil samples taken from the pale dunes associated with the present lake shores of Marootcootchanie and Marradibbadibba (features between Coongie and Toontoowarannie were not examined because of a lack of time), comprise sand rather than clay pellets, suggesting that the dunes originated from beaches. Since a number of the dunes are now some distance from present lake margins (Fig. 2) it seems that they were formed in the past at a time of higher lake levels. The morphology and colour of the dunes associated with the lakes in the whole of the Coongie system generally, suggest that they are late Holocene rather than Pleistocene features, (B. Wasson pers. comm.), indicating that the most recent rise in lake levels occurred some time during this period. Further work will be carried out on this hypothesis, before I relate my work back into Wasson's chronology.

As well as the site described above, work around Goyder and Marradibbadibba revealed other items of interest. While sites in this area were generally similar to those on the lakes further south, there was a greater variety of artefact types and raw materials here. An edge-ground hatchet manufactured from green stone was found on one of the sites (Lake Goyder 2) and flaked greenstones and rock-crystal was found on other sites. These differences seem to result from a relative lack of amateur collecting in these more remote lakes rather than for example, differences in site function or availability of raw materials. Goyder is not closer than Coongie to sources of these rock types and there appears to be no difference in food resources between the lakes. Many artefacts have been removed from around Coongie and from Coongie south to Innamincka by specialist collectors (see for example the collections in the South Australian Museum) and also by stockmen and tourists. The more remote areas in the lake system to the north of the old Coongie station, are not visited as much and fewer artefacts seem to have been collected from there. Collecting is an ongoing problem and will get worse as tourism increases. I will therefore take this into account when quantifying data on artefacts for the region in the future.

Conclusions

I found that there are specific constraints on the location and distribution of sites in the Coongie system. The availability of permanent or semi-permanent wa-

ter, for example, is probably the most important. Allowing for this, the presence of large, complex sites in the region, reinforces the historical data that population densities here (at least for the recent past) were high.

Regarding the chronology of settlement, I have found it difficult to look at the issue of Pleistocene settlement. I have confirmed that Pleistocene archaeological material is rare, but this could be partly due to the fact that most dunes associated with the lakes are quite recent. The dunes are recent, because the Coongie system is still operating. Future fieldwork will explore the issue of Pleistocene occupation further, with a study of Pleistocene-aged dunes associated with a series of now-dry lakes, located north of the Coongie.

Allowing for these problems with Pleistocene contexts, I would argue that the relatively late appearance of a more intensive occupation is a real phenomenon. I have surveyed many exposures of Pleistocene sediments in longitudinal dunes near the lakes and have found only more recent sites. Other researchers working closer to the main Cooper Channel have found the same pattern. It seems, therefore, that although the region was first occupied during the late Pleistocene, the area was only exploited on an intermittent basis until the mid to late Holocene. This pattern is also seen in other parts of the arid zone. How can we account for this phenomenon — can it be explained by factors such as climatic change for example? For the Coongie, it is possible there were higher lake levels in the late Holocene, and this could be having some impact on occupation. It is unlikely, however, that environmental shifts alone can explain this phenomenon. Higher ground water levels were present in the region in the late Pleistocene and in neighbouring areas such as Lake Frome during the early and mid-Holocene (Singh 1981), yet there is no evidence for corresponding increases in population at these times. Could the patterning be explained by another model, such as a continental-wide process of economic intensification during the mid to late Holocene, as outlined by Lourandos (1985)? Whilst it is tempting to see the Coongie data as supporting such a proposition, I have argued elsewhere (Williams 1987) that the detection of intensification in the archaeological record is complex. Given the preliminary nature of my work in the Coongie, I will therefore leave a more detailed discussion of this issue until I have completed further fieldwork.

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ABORIGINAL USE OF SUBTERRANEAN PLANT PARTS IN SOUTHERN SOUTH AUSTRALIA

P.A. CLARKE

CLARKE, P. A. 1988. Aboriginal use of subterranean plant parts in southern South Australia. *Rec. S. Aust. Mus.* **22** (1): 73–86.

This paper discusses the importance of underground plant parts as sources of food, medicine, string fibre, narcotics, pigments and drinking water in southern South Australia. Information was obtained from contemporary Aboriginal accounts and historical sources. In spite of an earlier view of the flora of this region as providing meagre food resources, it appears that some root species were very important. The paper also suggests that Aborigines in this area more actively managed their resources than has previously been thought.

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Although some early southern South Australian ethnographers reported plant roots as significant sources of food, Cleland (1957, 1966) considered that the flora was unable to provide significant Aboriginal food sources. The failure of Cleland to take into account the early reports of plant use in historical records and early ethnographies of the region has been documented for Victoria by Gott (1982, 1983) and by myself for southern South Australia (Clarke 1985a, 1985b, 1986a, 1986b). This article argues that Cleland's view can be seen as a reflection of an earlier opinion that Aborigines were wholly passive occupants of their landscape. In pursuing this aim, the study of Aboriginal plant use from southern South Australia is placed into a broader perspective of southern Australian Aborigines as being active managers of their environment and resources. In some cases, plant use records from outside southern South Australia are used as a guide to the species of root that could have been used in this region.

Sources and Methods

For the purposes of this article, southern South Australia is defined as the area receiving rainfall of at least 35 cm annually (Fig. 1). This region contains the lower portion of Eyre Peninsula, Yorke Peninsula, the Mt Lofty Ranges, the Fleurieu Peninsula, the Lower Murray River and Lakes, Kangaroo Island and the South East. Information obtained from early historical sources has been supplemented by consultations with Aboriginal people from the south-eastern region. This has been part of an ongoing, long-term research project involving the South Australian Museum and the Ngarrindjeri community. The project, begun in 1981, aims to record aspects of Aboriginal culture in this region. Major contributors, to the project and to this paper, include Ron Bonney and Lola Cameron-Bonney from Kingston in the South East of South Australia. Ron Bonney is a descendant of West Coast Aboriginal people but was brought up among the Moandik (his term for people of the Kingston area) in the South East of South Australia. He also has detailed knowledge of the Lower Murray cultural region. Lola Cameron-Bonney is a descendant of the Milmandjeri/Temperamindjeri groups from the northern end of the Coorong. Her family has had a deep interest in Aboriginal medicine and healing practices going back to pre-contact times. Another Milmandjeri/Temperamindjeri descendant who has provided important information is Fran Kernot from Kingston. The most significant sources from the Ngarrindjeri community of the Lower Murray have been Dick Koolmatrie and George Trevorrow from the Coorong and Meningie area, and Henry and Jean Rankine from Raukkan (Point McLeay) on the southern shore of Lake Alexandrina.

An ethnobotanical collection gathered during fieldwork in the Lower Murray and the South East by Steve Hemming and myself is being permanently lodged in the South Australian Museum. This collection at present numbers over sixty specimens with plant use records for over forty species; much of this is new information. Although the Museum has an existing ethnobotanical collection of about fourteen hundred specimens from most parts of Australia, the southern region was poorly represented before commencement of this project.

An analysis of the historical sources of ethnobotanical information from this region appears in Clarke (1986b). In the present paper, scientific plant names given are those used in 'The Flora of South Australia' (Jessop & Toelken 1986). South Australian Museum specimens referred to are referenced in the Endnotes by Anthropology Register number and by collector or source. The plant use information put forth

in this paper should not be considered as a complete listing of all plant roots that would have been used traditionally by Aboriginal people in southern South Australia. This is because ethnobotanic data historically have been recorded in a fragmented fashion and it is unlikely that I have located records for all the species that were used. However, it is likely that most of the major root species that were significant as foods were recorded by the sources cited in this paper. This paper also takes into account the possiblity that the Aboriginal use for some species, as recorded from contemporary oral sources, has significantly changed since European settlement. There are, in addition, plant species found in southern South Australia for which no record exists of Aboriginal usage. The underground parts of some of these, however, have been recorded as being utilized by Aborigines elsewhere in Australia. These are listed in Table 1. The distribution within South Australia of the main species discussed in this paper is summarized in Table 2.

European naming of plants used by Aborigines requires discussion before we can move on to the data in the paper. Nearly all the plants that the colonists encountered in Australia were totally unknown to

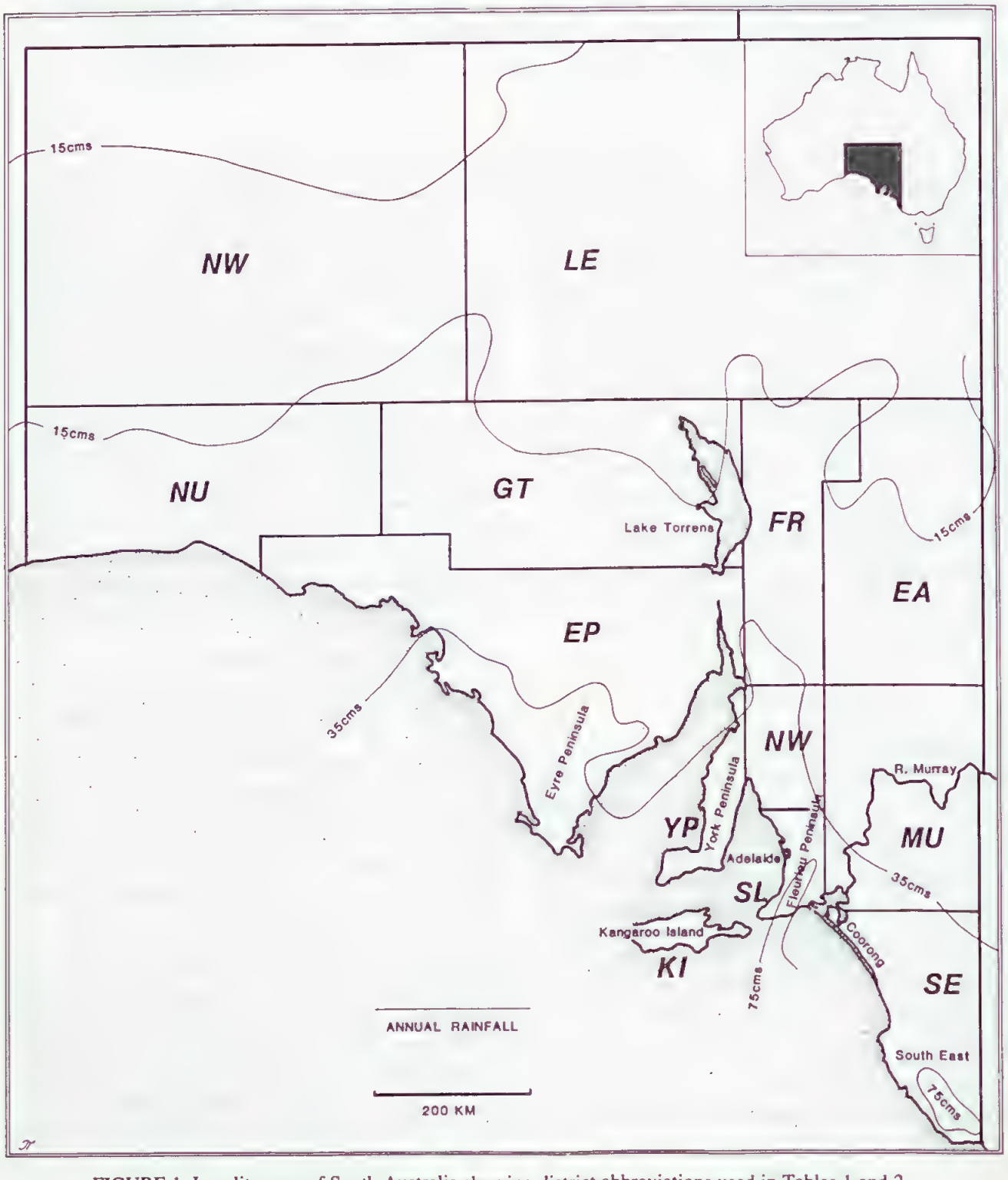

FIGURE 1. Locality map of South Australia showing district abbreviations used in Tables 1 and 2.

TABLE 1. A list of other possible sources of edible tubers.

Species	Common Name	Family	Locality For Recorded Use	Source	Occurrence in S.A.
Arthropodium milleflorum (DC.) Macbr (=*A. paniculatum*)	Pale vanilla-lily	Liliaceae	Vic.	von Mueller 1878: 213	SE
Arthropodium strictum R. Br.	Lily	Liliaceae	Vic.	von Mueller 1878: 213	NW FR EP NL MU YP SL KI
Bulbine bulbosa (R. Br.) Haw.	Bulbine lily	Liliaceae	Vic.	von Mueller 1878: 212	FR EP NL MU YP SL SE
Burchardia umbellata R. Br.	Milkmaid	Liliaceae	Vic.	von Mueller 1878: 212	EP SL KI SE
Caladenia species	Spider orchid	Orchidaceae	Vic.	von Mueller 1878: 212	Statewide
Caesia vittata R. Br.	Pale grass lily	Liliaceae	Vic.	von Mueller 1878: 213	FR EA EP NL MU YP SL KI? SE
Chamaescilla corymbosa (R. Br.) FvM ex Benth.	Blue squill	Liliaceae	Vic.	Hope & Coutts 1971: 107	Southern S.A.
Clematis microphylla DC.	Old man's beard	Ranunculaceae	W. Vic.	Dawson 1881: 20	FR EA EP NL MU YP SL KI SE
Convolvulus species	Bindweed	Convolvulaceae	W. Vic.	Dawson 1881: 20	Southern S.A.
Crinum flaccidum Herbert	Murray lily	Amaryllidaceae	E. States?	Maiden 1889: 20	LE GT FR EA EP MU
Cyrtostylis species	Gnat orchid	Orchidaceae	Vic.	von Mueller 1878: 212	FR EP NL MU YP SL KI S
Dicksonia antarctica Labill.	Tree fern	Dicksoniaceae	E. States?	Gunn cited Maiden 1889: 22	SL? SE?
Dipodium species	Hyacinth orchid	Orchidaceae	Vic.	von Mueller 1878: 212	SL SE
Diuris species	Donkey orchid	Orchidaceae	W. Vic.	Dawson 1881: 20	Southern S.A.
Gastrodia sesamoides R. Br.	Native potatoes	Orchidaceae	Tas.	Irvine 1957: 118	SL KI SE
Geranium species	Geranium	Geraniaceae	Vic.	von Mueller 1878: 212	Southern S.A.
Glossodia species	Wax-lip orchid	Orchidaceae	Vic.	von Mueller 1878: 212	NL SL SE
Lyperanthus species	Fire orchid	Orchidaceae	Vic.	von Mueller 1878: 212	Throughout southern districts
Microtis species	Onion orchid	Orchidaceae	Vic.	von Mueller 1878: 212	Throughout southern districts
Nymphoides crenata (F.v.M.)Kuntze (= *Limnanthemum crenatum*)	Wavy marshwort	Menyanthaceae	N. Qd	Palmer 1883: 100	LE MU
Nymphoides geminata (R.Br.)Kuntze (= *Limnanthemum geminatum*)	Entire marshwort	Menyanthaceae	N. Qd	Roth 1901: 13	KI
Portulaca oleracea L.	Common pigweed	Portulacaceae	L. Eyre Basin	Cleland *et al.* 1925:	NW LE GT FR EA YP SL SE
Prasophyllum species	Midge orchid	Orchidaceae	Vic.	von Mueller 1878: 212	Throughout southern districts
Pterostylis species	Green-hood orchid	Orchidaceae	Vic.	von Mueller 1878: 212	Throughout southern districts
Santalum murrayanum (T. L. Mitchell) C. Gardener (= *Fusanus persicarius*)	Bitter quondong, Ming	Santalaceae	E. States?	Maiden 1889: 32	FR EP MU YP SL SE
Sonchus species	Sow thistle	Compositae	E. States?	Hooker cited Maiden 1889: 59	Statewide
Thelymitra species	Sun orchid	Orchidaceae	Vic.	von Mueller 1878: 212	Throughout southern districts
Thysanotus patersonii R. Br.	Fringe lily	Liliaceae	Musgrave Ra.,S.A.; Vic.	Cleland & Johnston 1937: 213, von Mueller 1878: 212	All areas except LE
Thysanotus tuberosus R. Br.	Fringe lily	Liliaceae	Vic., N.W. Aust.	von Mueller 1878: 212 Crawford 1982: 42	SE
Wurmbea species (= *Anguillaria* species)	Early Nancy, Blackman's potatoes	Liliaceae	Vic. Mallee & Wimmera	von Mueller 1878: 213	Statewide

TABLE 2. South Australian localities of main species with useful subterranean parts.

Species	Family	Locality within S.A. (See Fig. 1 for area codes)
Boerhavia dominii	NYCTAGINACEAE	NW LE GT FR EA EP NL MU YP SL
Bolboschoenus caldwellii	CYPERACEAE	LE FR EP NL MU SL SE
Bolboschoenus medianus	CYPERACEAE	MU SL SE
Cyperus species	CYPERACEAE	Statewide
Dianella longifolia	LILIACEAE	Southern districts
Drosera whittakeri	DROSERACEAE	NL MU SL KI SE
Eucalyptus dumosa	MYRTACEAE	FR EA? EP NL MU SE
Eucalyptus fasciculosa	MYRTACEAE	MU SL KI SE
Eucalyptus gracilis	MYRTACEAE	NW NU GT FR EA EP NL MU YP SL SE
Eucalyptus incrassata	MYRTACEAE	NU EP NL MU YP SL KI SE
Eucaluptus oleosa	MYRTACEAE	Statewide
Lavatera plebeia	MALVACEAE	Statewide
Microseris scapigera	COMPOSITAE	GT FR EA EP NL MU YP SL KI SE
Oxalis species	OXALIDACEAE	Statewide
Polyporus mylittae	POLYPORACEAE	Southern districts
Pteridium esculentum	DENNSTAEDTIACEAE	EP SL KI SE
Santalum murrayanum	SANTALACEAE	FR, EP MU YP SL SE
Triglochin procerum	JUNCAGINACEAE	LE, MU SL KI SE
Typha species	TYPHACEAE	NW LE FR MU YP SL KI SE
Xanthorrhoea species	LILIACEAE	NW FR EP YP NL MU SL KI SE

science. The folk terms that were used for plants in the settler's country of origin were often imposed upon plants to which they generally showed only superficial resemblance. For example, the early ethnographies of southern South Australia contain descriptions of Aboriginal edible roots which are cited as native potato, native parsnip, native radish, native carrot, native dandelion, onion grass and native truffles. There is evidence to suggest that some of these descriptions have been used independently in several accounts of different species. Some also appear to have had the status of commonly used names whereas others seem to have been used only by ethnographers when attempting to describe a species with no other name.

Determining the reasons for a plant being given a particular name is sometimes difficult. In some cases, the names refer to the use and properties of the species. In other cases, the plants were named solely on appearance. For example, most records of roots described as being like a radish are considered by Gott (1983) to be *Microseris scapigera* due to the similarity between the root of the latter and the cultivated radish. However *Microseris scapigera* is also commonly referred to as the yam daisy because of the similarity of the above ground parts of the plant with those of common daisies. To make the task of identifying some of these European terms today even more difficult, some of the folk terms associated with Aboriginal words for edible roots may have only been used for a short period in fairly restricted, local areas.

The transfer of plant names between Aborigines and Europeans also occurred. There are many records of the use by Aborigines of Aboriginal terms for European foods and plants. For example, there are the Adelaide words 'parangota' for potato and 'parre' for rice (Wyatt 1879: 174, Williams 1839: 295, Teichelmann & Schuermann 1840: 37). The term parangota was also used for an unidentified species of Aboriginal root food. On the other hand, Aboriginal terms for Australian plants were sometimes adopted by Europeans and, in some cases, their use has continued to the present. Examples of this are 'Pitjuri ' (widely used term for *Duboisia hopwoodii*), 'Mantari ' (South Australian and Victorian term for the fruit, *Kunzea pomifera*), and 'Murnong' (Victorian term for *Microseris scapigera*).

Ethnographic Details of Root Use

Boerhavia dominii Meikle & Hewson NYCTAGINACEAE

This species is commonly called tar-vine and has been suggested by Cleland (1966: 135 – his name *B. diffusa* L.) as the possible identity of one of the roots listed by Schuermann (1879: 216) as having been eaten by the Port Lincoln Aborigines. Black, in his 'Flora of South Australia' (1943: 333), mentions that the root was eaten by Aborigines but does not give a source or locality for this statement. It is highly likely that *B. dominii* is often the plant described in the ethnographic record under the category 'edible roots'. Apart from in the South East region, this species is found throughout southern South Australia.

Bolboschoenus sp. CYPERACEAE

This species is most likely the 'poolilla' described by Angas (1847a: 101) as a 'triangular species of grass or reed' and eaten by the Aboriginal people of the Murray River. Eyre (1845, 2: 254, 269) refers to reed roots called 'belillah' that were an important source of food

and found in abundance on the flats of the Murray. Eyre described them as walnut-sized and prepared by being roasted and pounded between stones into a thin cake. Gott (1982: 59–62) considers the 'belillah' to be *Scirpus medianus* **V. Cook** which is a synonym for *Bolboschoenus medianus* **(V. Cook) Sojak**. In this article I follow Jessop & Toelken (1986: 2007) and refer to this plant by the latter name. Cleland collected roots of a species of *Scirpus* (or *Bolboschoenus*?) from the mouth of the Inman River, south of Adelaide, in January 1940 and wrote that they were probably eaten[1]. However, he did not state the reasons for this suggestion. Von Mueller (1878: 213) lists *Scirpus maritimus* (called *Bolboschoenus caldwellii* **(V. Cook) Sojak** by Jessop & Toelken 1986: 2007) as a source of edible roots used as food by Victorian Aboriginal people. It was apparently an edible root species that was available in autumn and was roasted. This species is widespread in southern South Australia.

Cyperus sp. CYPERACEAE

Tindale (1974: 60) states that the Peramangk people of the Mt Lofty Ranges were able to exist all year round without venturing onto the plains because of the availability of *Cyperus* corms. *Cyperus* species have been recorded as major food source from other regions such as Central Australia (Cleland & Johnston 1933: 115, 118; 1937: 213) and north-western Australia (Crawford 1982: 40). It is possible that some of the records of 'Native Onions' refer to species of *Cyperus*. For example, Tindale (1981: 1880) records that the southern South Australian Aborigines ate the onion grass corms throughout the year except during the growing season. However, Tindale's records of *Cyperus* and onion grass corms mentioned above may also refer to a species of *Bolbschoenus*, as this genus is also in the Cyperaceae family.

Dianella longifolia R.Br. LILIACEAE

The reddish brown roots of this plant, commonly referred to as the pale flax-lily, were boiled and the solution taken internally for colds according to Lola Cameron-Bonney. It was termed peeintook by the Milmandjeri/Temperamindjeri, but was called pintook by the Moandik[2].

Drosera whittakeri Planchon DROSERACEAE

D. whittakeri, or the scented sundew, is the most likely species referred to by Worsnop as an Aboriginal source of pigment:

> The native tribes around Adelaide obtained a brighter red pigment from the bulbous roots of the small sundew plant, which contains a small red pustule between the brown outer skin and the white inner bulb. This red pustule they used to scrape off and mix with fat for coloring the fillet of opossum hair-twine which they bound round their heads (Worsnop 1897: 15).

The blister-like growth or pustule of this bulb may have been used for decorating the large bark shields made by the Adelaide people for deflecting reed-spears. Stephens records that during their manufacture they 'received a coating of pipeclay or lime, and were then ... ornamented with red bands made from the juice of a small tuber which grew in abundance on the virgin soil' (1890: 487).

It is interesting to note that it is European oral tradition in South Australia that early settlers in the Adelaide area also used this species of sundew as a source of pigment for ink (R. Matthews pers. comm.). It is highly likely that the use of this plant by Europeans was copied from Aboriginal people in the area.

Eucalyptus sp. MYRTACEAE

Eucalyptus roots were sometimes used as a source of drinking water and as food. The need to obtain water for drinking from plant roots in the southern South Australian region was probably confined to the mallee areas of Eyre Peninsula, Yorke Peninsula, Murray region (away from the river) and parts of the South East. This is because surface supplies of freshwater are scarce in these areas, despite relatively high annual rainfalls. Elsewhere in the southern regions, water from springs and soaks appears to have been available all the year round. For instance, Hemming (1985: 25) records the ease with which Aborigines of the Fleurieu Peninsula obtained drinking water from coastal springs during the summer months even when local creeks and soaks had dried up. Gara (1985: 6–11) discusses methods of obtaining water in arid regions of South Australia. Smyth (1878: 220–221) also records similar uses of the *Eucalyptus* roots from the mallee areas of Victoria.

Magarey (1895) provides the most detailed account of water extraction from roots. Some of Magarey's data on root water comes from coastal areas of the Great Australian Bight and depends on the data of Eyre (1845, 1: 349–351, 359, 2: 248–249). Margarey describes in detail the trees that were used by the Aborigines as a supply of root water and the methods for the extraction of it. In his list of 'water-trees', Magarey (1895: 4) includes species of *Eucalyptus* such as *E. dumosa* **Cunn. ex Schauer**, *E. gracilis* **FvM**, *E. incrassata* **Labill.**, *E. oleosa* **FvM ex Miq.**, and *E. fasciculosa* **FvM** (Magarey's *E. paniculata*). All of these trees exist in the mallee areas of southern South Australia. It was through the availability of root water that the Aborigines were able to enter arid regions. The Ngarkat people of the Murray Mallee relied heavily on

root water and only needed to travel to the Murray River at times when severe drought had decreased their otherwise reliable sources of water (Tindale 1974: 62).

The use of *Eucalyptus* roots as food is recorded by Maiden (1889: 27) who says that the South Australian Aborigines powdered the bark of the root of *E. dumosa* and perhaps other species and ate it by itself or with other plants. Maiden claims that it was called 'Congoo' but does not mention the area in which this name was used. This mallee is found over much of southern South Australia and the areas to the east of the Flinders Ranges. Eyre (1845, 2: 250) states that the smaller roots, less than an inch (2.5 cm) in diameter, were used as food by the Aborigines (presumably from southern Australia). He records that:

> The roots being dug up, the bark is peeled off and roasted crisp in hot ashes; it is then pounded between two stones, and has a pleasant farinaceous taste, strongly resembling that of malt. I have often seen the natives eating this ... but it is, probably, only resorted to when other food is scarce (Eyre 1845, 2: 250, see also p. 224, 251, 273).

There is also a record of the use of *Eucalyptus* roots as medicine. Moriarty (1879: 52) states that rushes and the roots of the Mallee tree were boiled (presumably together) and drunk for internal afflictions by the Narrinyeri (Ngarrindjeri). Lower Murray Aboriginal person, Laura Kartinyeri, says that the roots of a species of *Eucalyptus* were boiled and the solution drunk for colds. Dawson (1881: 57) recorded the use of the roots of a narrow-leaved species of gum tree as a cure for indigestion. In this case, the roots were infused in hot water and the resulting solution drunk as a tonic.

Lavatera plebeia Sims MALVACEAE

The roots of a white flowering variety of mallow were recorded as commonly used as food by the Aborigines of South Australia (Bailey, cited in Maiden 1889: 37). They were described as having the consistency of parsnips. Maiden considers that this plant is *L. plebeia*, tha Australian hollyhock or mallow. Wyatt (1879: 170) lists in his Adelaide and Encounter Bay vocabulary the terms 'kannoonta' for mallow plant and 'peecharra' for mallow shrub. The latter appears to have been used as a source of fibre for string making: Wyatt (1879: 176) records the term 'teeyappe peecharra' as 'chewed fibre of mallow'. Eyre (1845, 2: 311) states that the fibres of the root of the mallow were used in net making, though he does not state in what area. *L. plebeia* has been recorded as used for this purpose elsewhere, such as the northern Flinders Ranges (Cleland & Johnston 1939: 176) and the Lake Eyre Basin (Clarke n.d.).

Microseris scapigera (Sol. ex A. Cunn.)Schultz-Bip. COMPOSITAE

This species, commonly known as the yam-daisy, is possibly another of the many plants recorded simply as 'edible root' from southern South Australia. The tuber is recognized as one of the major food sources for Victorian Aborigines (Gott 1983: 2) and the fact that it occurs widely in southern South Australia suggests that it was probably a major source in this region also. Bellchambers (1931: 132) states that of all the tubers eaten by the Murray River Aborigines, he thought the yam was the most prized. Unfortunately it is not clear whether Bellchambers' 'yam' is *M. scapigera*, and it is possible that he is referring to another root species.

In the Adelaide and Encounter Bay area, the edible root terms 'umba' and 'yungumba' were said to be *Microseris* by Wyatt (1879: 176). One of the Port Lincoln terms for 'edible root', 'ngamba', (Schuermann 1879: 216) probably referes to *M. scapigera*, as it is similar to terms for *Microseris* recorded in cognate languages, such as that recorded from the Adelaide and Encounter Bay area. The yam-daisy was used on the west coast of South Australia. The South Australian Museum has specimens of *Microseris* roots that were registered in 1913 as an Aboriginal food from Elliston[3]. Also, *Namba* is the recorded word for this species used by the Adnyamathanha of the Northern Flinders Ranges (McEntee 1986: 11 — his Adnamatana). Berndt & Vogelsang (1941: 10) list the term *Ngumpa* for 'Yam' from the Ngadjuri people of the Mid-North. In view of the fact that Berndt and Vogelsang recorded different words for wild potato and wild carrot, it is likely that their yam refers to a single species, such as *Microseris*, rather than being a collective term for all edible roots. Gott (1983: 14–15) suggests that the lower Murray term *Ngamko*, meaning 'native radish' (Moorhouse 1935: 30), is likely to be *M. scapigera*. Another possible record of the yam-daisy is provided by Sanders (1907, 9: 69) who states that the local Aboriginal families in the Echunga area, dug up the roots of a 'dandylion', called 'waldies'. Gott (1983:14–15) also considers that the Booandik terms 'Moorna' or 'Mar-o-ngire,' described as 'edible roots' by Smith (1880: 129), refer to this species in the South East. Gott (1983: 8) quotes a note by Bailey on a specimen of *Microseris* from South Australia in the Queensland Herbarium, which states that the colonists of South Australia used to eat the roots of this plant following the practice of the Aborigines who relied on it as food.

Oxalis sp. OXALIDACEAE

Angas (1847a: 84) records that in the South East, Aboriginal women dug up the edible roots of a species of *Oxalis*. For the Adelaide people, Stephens claims that:

> The root most sought after is a highly nutritious oxalis resembling a small carrot and tasting like cocoanut. It is dug up chiefly by the women, with a heavy pointed stick five feet long which they force, by throwing, into the earth to the depth of about eight inches, thereby bringing up the object of their search. It is very abundant and discovered

by leaf. Three persons have been lost since the foundation of this colony, who would probably have been saved had they known where to look for the root (Stephens 1923: 7).

There are other records of edible 'Native Carrots' that may refer to *Oxalis*.

Polyporus mylittae Bertr. POLYPORACEAE

The common names for this species of fungus – native truffle and Blackfellows bread (Daley 1931: 28) –suggest its edible qualities. The species is possibly the edible fungus mentioned also by Eyre (1845, 2: 269) as found below the ground. Maiden (1889: 46) records that the Tasmanian Aborigines looked for truffles in the ground about the vicinity of a dead tree. The South Australian Museum has specimens of *Polyporus mylittae* listed as Aboriginal foods from Myponga (South Australia)[4], Lake Albert (South Australia)[5], Gippsland (Victoria)[6] and north Tasmania[7]. Most of the above specimens measure above 5 cm in length, breadth and height. The biggest is from Tasmania and measures 26.5 by 16 by 10 cm. The ethnographic record indicates that this species was used as food despite Cleland's (1966: 135) doubt that it could be eaten due to its toughness.

Dawson (1881: 20) records a species of large underground fungus from western Victoria called native bread, about the size of an ordinary turnip, that was eaten uncooked and which tasted, in his words, 'very good'. Smyth (1878: 209) claims that the native truffle 'was much sought after by the natives' and that he had seen specimens weighing several pounds; further, that in some districts, a fungus weighing fifty pounds (about 23 kg) is occasionally found. Bonwick (1870: 15) states that in Tasmania, this fungus was peeled and then roasted before being eaten. However, Daley (1931: 28) claims that it was generally eaten raw by the Australian Aborigines, the dirt simply being shaken off. In view of evidence, it is difficult to support Cleland's doubts about this fungi. Other species of subterranean fungus were probably also eaten.

Pteridium esculentum (Forst.f.) Cockayne DENNSTAEDTIACEAE

This species is commonly called bracken fern and it is listed here as a probable source of food for the southern South Australian region. Its use in Tasmania has been documented by Robinson (cited in Gott 1982: 64). In this record, the rhizomes and young fronds were chewed. Dawson (1881: 20) claims that the western Victorian Aborigines made a kind of bread from the root of the common fern that was roasted in hot ashes and beaten into a paste with a stone. It is possible that Dawson was referring to bracken (Gott 1985: 8). Maiden (1889: 54) states that the starchy rhizomes of this plant were eaten both raw and roasted but he does not give any locality. Mathews (1903: 73) recorded the Bungandity name 'Me-e' for bracken fern in the South East and Smith (1880: 129) recorded the term 'Maa-aa' for fern root for the same group of people (Smith's Booandik). In Tasmania, according to Robinson (cited in Hiatt 1967: 130), bracken roots were cut into short pieces and roasted in ashes.

In spite of the records of the use of this fern outside South Australia, it does not appear to have been a major food source in the southern South Australian region. It was not mentioned by early ethnographers and it was not known as a food source by Ron Bonney and Lola Cameron-Bonney who were able to describe several other types of edible roots for the South East region. However, Bonney did maintain that they were edible because pigs will eat the roots. It was possibly a food only resorted to by humans in difficult times.

Triglochin procerum R.Br. JUNCAGINACEAE

This species, commonly called water ribbons, has numerous and very fleshy roots. It is possibly the 'Maracrow' recorded by Bellchambers (1931: 132) as a food with 'succulent roots'. Cleland (1966: 132) suggests that the tubers of *T. procerum* were used by the Aborigines of the coastal areas of Adelaide and contiguous regions. He lodged at the Museum a food specimen of this plant from the Onkaparinga River at Noarlunga, south of Adelaide, but did not give the source of his information concerning its Aboriginal use[8]. Use of this root species as food has been recorded from Victoria (von Mueller 1878: 213) and Arnhem Land (Specht 1958: 483). In the latter account, it was eaten raw or cooked in the fire for about ten minutes and apparently had a nutty taste. On Groote Eylandt the roots were eaten raw or roasted in the hot sand under the fire and were an important part of the diet (Levitt 1981: 39). This is a palatable, easily obtained food which was probably highly prized.

Typha sp. TYPHACEAE

The recorded Aboriginal names for most edible roots described as growing on river banks and in water for the southern South Australian region probably refer to *Typha*, commonly known as the flag or bulrush. This is especially so for such roots also listed as a source of fibre for string making. Angas (1847a: 55) states that in southern South Australia the bulrush root was chewed and then the fibres scraped, using freshwater mussel shells, for the purpose of making cord for their mats and baskets. Angas (1847a: 90) records that this fibre is also converted into rope out of which the southern Aborigines make their fishing lines and nets for hunting and fishing. Teichelmann & Schuermann (1840: 53) describe the Adelaide word 'warnpa' as a farinaceous root growing on the river banks, the nutritious part is eaten and the tough parts made into strings, nets, etc.'. Gell (1904: 94) also recorded this

word from this area but he simply described it as an 'aquatic plant'. However, based on the fact that 'warnpa' was an aquatic plant whose root was used as both a food and for fibre, it is most likely to be *Typha*.

In the Lower Murray River area, *Typha* appears to have had the name 'Moomoorookee' applied to the whole plant and 'Menungkerre' to the root (Taplin 1859–79: 47). Ngarrindjeri people, Henry and Jean Rankine, use the term, 'Manungkari', for the bulrush in general. Cleland (1966: 138) records 'Manungkari' as the Murray River name for 'Typha', but he gives no separate name for the root. Fran Kernot states that she and her family used to eat the bulrush root when they lived along the Coorong in the 1940s and into the 1960s. The name she gave for the plant was 'milmuruki' and she described it as being two feet long (about 60 cm). It was cooked in ashes or boiled. Ron Bonney said that the Moandik name for the Bulrush was 'manakari' and that the root was about eighteen inches long (approximately 45 cm) and was easy to pull out. He stressed that this food source was available throughout the year.

The importance of *Typha* to the overall diet of the South East Aborigines is summed up by Angas (1847a: 89) who states that the 'staff of their existence is the bulrush root which the women gather among the reeds...'. Once on his trip through southern South Australia, Angas (1847a: 59) met an Aboriginal woman carrying an infant on her back chewing the 'favourite bulrush root'. Another child was standing alongside also chewing a long piece of bulrush. Angas (1847a: 92) recorded the name of a Lower Murray Aboriginal person 'Chembillin', meaning chewing the bulrush root'.

Eyre also stressed the usefulness of *Typha* or the broad flag-reed, as he called it. He states, for example, that: 'In all parts of Australia, even where other food abounds, the root of this reed is a favourite and staple article of diet among the aborigines' (Eyre 1845, 2: 62). Further, he records that the bulrush was the staple food source through out the year on the Lower Murray but that it tasted best after the floods had receded and the tops had decayed and been burnt off (1845, 2: 269). Krefft says, concerning the bulrushes, that on the New South Wales section of the Murray River:

> at a certain period, I believe January and February to be the months, the women enter these swamps, take up the roots of these reeds, and carry them in large bundles to their camp; the roots thus collected are about a foot to eighteen inches in length, and they contain besides a small quantity of saccharine matter, a considerable quantity of fibre. The roots are roasted in a hollow made into the ground, and either consumed hot or taken as a sort of provision upon hunting excursions... (Krefft 1862, 5: 361).

Angas (1847a: 58) says that bulrush roots were steamed between heated stones beneath ovens or cooking fires resembling kilns. Angas (1847b: plate 47) illustrates such a kiln. Beveridge (1889: 71) states that on the Murray, the outer cortex of the bulrush root was removed and the inner part chewed. Angas (1847a: 90) claimed that he saw large numbers of heaps of the fibrous parts of the bulrush roots in the shape of pellets around the campsites. Dawson (1881: 20) notes for the western districts of Victoria, that the root of the bulrush was eaten uncooked as a salad and had a taste resembling celery. Thomas (1906: 116) records that in South Australia the bulrush root was usually eaten with mussels. The roots were sometimes taken as provisions during hunting and gathering activities as noted in the accounts of Krefft and Angas cited above.

Taplin (1859–79: 151) indicates that the Aborigines of the Lower Murray River area were often paid by settlers to collect large amounts of bulrush root. Mason, Aboriginal Protector on the Lower Murray in the 1850s, lent a boat to some Aboriginal people from the Point McLeay Mission so that they could collect 'Moomoorooke' for a storekeeper at Wellington on the Murray. Taplin on one occasion went with the Aboriginal women to collect the roots in the Point McLeay Mission whale boat; he notes that he gave them a good price for the plants (1859–79: 57). This is not the only record of Europeans using this root: Mr G.W. Batty, a long time European resident of the Victor Harbor area, remembers the bulrush also being eaten by local settlers up until the 1920s[9].

Xanthorrhoea sp. LILIACEAE

The ethnographic record of southern South Australia suggests that the roots, at least of some species of *Xanthorrhoea* –commonly called grasstree or yacca, were eaten. Schuermann, describing the plant foods of the Port Lincoln Aborigines, claimed that:

> the only root known to me as eaten in the raw state is that of the grasstree which grows in great abundance on the barren hills and plains of Port Lincoln, and is consumed by the natives in prodigious quantities at different seasons of the year (Schuermann 1879: 216).

Angas (1847a: 84) records that the roots of the smaller species of *Xanthorrhoea* (probably *X. minor* **R.Br.**) of the South East were eaten. Of the smaller species of grasstree, Angas reports that:

> They eat only the lower portion of the leaves at their junction with the root, drawing them out of the ground, and biting off that part which was underneath the soil: the flavour resembles that of a nut (Angas 1847a: 203).

According to Pate & Dixon (1982: 141), probably only the young roots would have been utilised.

Ron Bonney stated that witchetty grubs (larvae of wood-boring and root-feeding beetles and moths) could be obtained from the roots of the *Xanthorrhoea*.

Unknown species–medicine LEGUMINOSAE

Dick Koolmatrie, an Aboriginal man from Meningie, said that the root of a yellow flowered plant called 'Koorunthunta' was used as a cure for coughs and colds. The long root was boiled and then chewed to 'get the oil out'. Laura Kartinyeri says that this plant is a bush which has red and yellow flowers like that of a pea. She said that the root tasted like liquorice powder and that it was used as a medicine. Ron Bonney and Lola Cameron-Bonney say that the roots of this plant were boiled and the solution used for stomach trouble and that it is 'good iron medicine for problems with the blood'. They said that the flowers were like a yellow pea with a red-brown centre. The leaveswere said to be long. Ron Bonney claims that it was called *Koorunthunta*. However, Lola Cameron-Bonney said that her grandfather, Alfred Cameron, had called it 'Koolunthunta'. This probably reflects a difference in dialect. I previously considered this plant to be the yam daisy *(Microseris scapigera (Sol. ex A. Cunn.) Schultz-Bip.* based on a brief description given by Dick Koolmatrie (Clarke 1985a: 5). More recent fieldwork with Ron Bonney, Lola Cameron-Bonney and Laura Kartinyeri suggests that the classification of this plant is not amongst the Compositae (as is *Microseris*) but rather in the Leguminosae. The identity of this species will only be known for certain when a specimen can be obtained. Despite several attempts to find this plant with Ron Bonney and Lola Cameron-Bonney, we have not been able to do so. The lack of remaining large stands of mallee scrub in the upper Coorong area has made finding this root species (and others) difficult.

Unknown species – narcotic Family unknown

Angas (1847: 73) refers to a plant root that was obtained from the scrub and which was frequently used to cause intoxication. Cleland (1966:120) considers it to be Anthocercis myosotidea **FvM** [now known as *Cyphanthera myosotidea* **(FvM). Haegi**], and may have based this on a suggestion by von Meuller (1878: 222–223) that species of this genus be tested for the 'stimulating power' of pitjuri [Duboisia hopwoodii **(FvM)FvM**], a well known narcotic used in central Australia and closely related to *Anthocercis*. I previously considered that this narcotic was possibly the roots of *Duboisia* or *Nicotiana* (Clarke1987: 12–13). Latz (pers. comm.), however, states that it is unlikely that the roots of these plants would have been used in preference to the leaves. Gott (pers. comm.) suggests that it may be the roots of the ming [*Santalum murrayanum* (T.L. Mitchell) C.Gardner]. Stone (1911: 445) records that the root and bark of this plant were used by the Lake Boga people of Victoria to make a stupefying drink.

Unknown species – food LEGUMINOSAE?

Sanders (1907–9: 69) records that the roots of a species of vetch, called 'Tidlars', were eaten by the Echunga people.

Unknown species – food Family unknown

Ron Bonney and Lola Cameron-Bonney state that wild onions were eaten by the Aboriginal people in the South East region. The brief description given of the appearance of this plant indicates that is not a species of *Cyperus*. Field trips to the remnant pockets of scrub in this area have not yet produced a specimen. Thus its identity remains unknown for the present.

Unknown species – food Family unknown

A species known by contemporary Aboriginal people as wild parsnip is another root that was used as food in the South East. A specimen of it is yet to be found.

Unknown species – food Family unknown

According to Lola Cameron-Bonney, the Coorong Aboriginal people ate a wild potatoes that they called 'Murunguooni'. Ron Bonney claimed that the same plant was called 'Punmanthi' by the Moandik. Without a specimen, the identity of this plant is uncertain.

Unknown species – food Family unknown

Ron Bonney and Lola Cameron-Bonney described a type of wild carrot that not only had an edible root like a carrot but had a similar top as well. This plant grew in the sandhill areas of the South East and the Hummocks of the Coorong. Recent attempts to locate this plant for identification have failed as it now appears to be locally very rare. It is possible that the 'Wild Carrots' mentioned by Sanders (1907–9: 69) as being eaten by the Echunga people, may refer to a species of *Bulbine*, *Oxalis* or similiar plant.

The Significance of Roots

Of the food sources listed and discussed above, 17 different plants with subterranean parts were definitely used in the southern South Australian region. A further 30 were possibly used. This is some indication of the diversity of root food available in the temperate regions across southern Australia. In the south-west of Western Australia, Grey (1841: 263, 291) recorded the use of 29 types of root and there were probably others. In Victoria, Gott (1982: 60) states that 218 species were possibly used, 166 of these being orchids. Plomley (cited in Gott 1892: 60) lists 10 different root species

for Tasmania although there would undoubtedly be many more. It appear from ethnographic and contemporary sources that at least some species of roots (*Microseris, Typha, Triglochin* and *Oxalis* for example) held a significant place in the diet of southern South Australian Aborigines because they were available for all or most of the year. Some roots, such as those of the *Eucalyptus*, were probably more important as drought or 'hard time' foods.

In spite of the difficulty in obtaining from the historical record quantitative data on the proportions of plant and animal foods in theAboriginal diet, the early ethnographies provide an indication of the range of foods available. It is assumed that those foods approaching the status of staples are present in the ethnographic record. It is also clear that some of the early travellers through southern South Australia were struck by the reliance of Aborigines on certain species of roots. As noted, Angas (1847a: 89) considered the bulrush root to be 'staff of their existence'. This was based on his many sightings of Aboriginal people gathering and eating bulrush roots during his trip through southern South Australia. Another record of Aborigines collecting tubers is from Eyre. As he approached the Flinders Ranges from the south on 10 May 1839, he 'found a good many natives digging yams' (1984: 198). On 27 June 1840, as he was travelling just south of Crystal Brook, in the northern Mount Lofty Ranges, he 'came suddenly upon a small party of natives engaged in digging yams, of which the plains were full ... (1845, 1: 42).

Eyre noted that the root called 'Belillah' (probably *Bolboschoenus medianus*) was an important food source and, which, as we have noted, was abundant on the flats of the Murray (Eyre 1845 2: 269). Eyre's interest in Aboriginal use of roots appears to be based, in part, on his use of them to supplement his own food and water provisions when travelling across Australia on his expeditions (1845, 1: 370–371, 2: 56–57, 62–64, 72, 248–249).

However, not all early accounts of Aboriginal food and food-getting in southern Australia illustrate the importance of plants. Some sources have a bias towards foods resulting from male activities. This was possibly because most of the early accounts are from men. This historical record certainly documents the division of labour by gender for food production. For example, Teichelmann states that when the Adelaide people are travelling: 'The men start first, carrying nothing but a small net bag and hunting implements,– the women, burdened like camels, follow, gather & prepare on the road vegetable food for the night, whilst the men are looking out for meat' ... (Teichelmann 1841: 7).

This division was enshrined in mythology, too. Teichelmann describes how, in the Adelaide Aboriginal beliefs, 'The Pleiades are girls gathering roots and other vegetables; the Orion are boys, and are hunting' (1841: 9). Men hunted larger game that, generally, would have contributed less in quantity to the overall requirements, but which was probably more highly valued by the group.

Another factor contributing to possible bias in the ethnographic record was that events such as the spearing of emu and kangaroo may have left a more enduring impression on the memories of the recorder than those of the daily gathering of, for example, bulrush roots by the women and children.Thus the recording of hunting and gathering techniques, often written up many years after the events were observed, has tended to over-emphasize the hunting aspect and to devalue the gathering component. For example, Worsnop (1897) and Taplin (1874) have published detailed accounts of fishing and snaring for southern South Australia, which barely mention plant foods. Similarly, Bulmer states that the food of the Aborigines of the Lower Murray (New South Wales/Victorian section), Wimmera, Gippsland and Maneroo districts 'consisted chiefly of animal substances, to which were added a few vegetables and some roots, which must have been very hard of digestion' (Bulmer 1887: 15).

Early sources, such as Bulmer, did not appreciate the seasonal fluctuation of meat and vegetable foods. Some animal foods, such as fish, emu and kangaroo, may have been highly favoured foods when available. Yet vegetable foods such as roots were probably the main stay when meat was not easily obtainable. A report from the Statistical Society in 1842 gives some idea of the seasonality of Aboriginal food in the Adelaide area[10]. In spring, vegetables and grubs were mainly eaten. With the commencement of summer, the eggs and young of birds were eaten as were kangaroos, emus, fish and lizards. During the hottest part of the year, possums and *Acacia* gum were obtained, while in autumn, berries and nectar were available. In the winter, a variety of roots were consumed, as were possums and other animals. The report illustrates that roots were used as food at a time of the year when other food sources, perhaps more highly favoured, were not procurable.

Another factor distorting the views of early writers on the southern Aboriginal diet was the rapidity with which indigenous root and many other vegetable foods were replaced by European foodstuffs. Information given by Aboriginal people today on bush foods obtained in the Lower Murray area in the last 50 to 60 years, indicates far less use of roots than of other indigenous foods such as fish, water fowl, kangaroo, emu and berries. The European food obtained from farms and towns probably led to a significant decrease

in consumption of less favoured vegetable foods. As stated above, the bulrush root, for example, contains a great deal of fibre. All indigenous roots used as food sources with unfavourable properties (in taste or texture or difficulty of procurement or preparation) would have been replaced by foods such as European potatoes, turnips, flour and rice. This fact must be taken into consideration when reconstructing Aboriginal plant food lists from contemporary sources.

The above reasons, as well as the lack of quantitative data on the importance of vegetable food, led scholars such as Cleland to understate the role of this component in the overall diet of Aborigines. Cleland considered plant foods in southern South Australia to be 'hardly procurable' and believed that the Aborigines were essentially meat-eaters (1966: 188–119). Gott (1982, 1983) and myself (Clarke 1985a, 1986b) have undertaken detailed historical analyses of Aboriginal plant use records combined with field work with Aboriginal people in an attempt to refute this position as it applies to southern Australia. Cleland's treatment of Aboriginal plant use in southern Australia does not reflect the diversity of plant use and relies on inadequate documentation of use. He also did not fully appreciate the amount of information on plant use that could have been gleaned from the ethnographic record and from Aboriginal informants of the period in which he conducted his research.

Passive Wanders or Active Resource Managers?

Assuming Cleland was mistaken in his view, the question, then, is how he came to his conclusion about the poor food value of the southern Australian vegetation. Cleland had a medical background and made significant scientific contributions in the areas of medicine, human biology, ethnology and botany. He published widely from the 1900s through to the 1960s in these fields. Cleland (1966) claims that the Aborigines remained hunters and gatherers primarily because the Australian continent did not have plants and animals suitable for agriculture and pastoralism. He maintains that:

> The animal and vegetable surroundings of the first comers to Australia were singularly unfavourable for the development of a pastoral or an agricultural people. In fact such knowledge as they might have possessed in regard to these matters before their arrival could have been of little or no use and must have been quickly forgotten from want of application (Cleland 1966: 113).

This statement illustrates how Cleland linked the Australian biota closely with the development (or perhaps even degeneration) of the Aboriginal mode of subsistence. It is probable that the (mistakenly) low estimates ofAustralia's Aboriginal population levels prior to colonization had a significant influence on Cleland's views concerning the carrying capacity of the southern Australian environment. For example, he argued that 'To what extent these areas [south and central Australia] were occupied depended primarily on the availability of food and water' (Cleland 1966: 126). Cleland's approach reflects the influence that the biological sciences had on his ethnographic work. Working largely with medical and biological models, Cleland treated the population levels and distribution of Aboriginal hunters and gatherers as with any other non-human organisms, and as the product of a set of environmental determinants, largely independent of the cultural dimension. However, it is now widely accepted by researchers studying hunters and gatherers, that in general, the lack of intense pressure exerted by the hunting and gathering mode of subsistence is such that food alone would not limit long term population growth (see Williams & Hunn 1982). Cleland relies on and reinforces an old view of the stereotypic hunter and gatherer as a passive food collector with little or no control over the environment.

These stereotypes have been attacked by Hallam (1975, 1986) whose description of Aboriginal land use patterns in the south-west of Western Australia, an area similar in some respects to south-eastern Australia, illustrates how the Aboriginal people living here actively managed their resources. This region had a comparatively large, semi-sedentary population living in areas close to their main food resources – for example, the swamps where bulrush roots were obtained and the 'warran' grounds where yams (*Dioscorea hastifolia* Endl.) were procured. So intensive, extensive and successful were the efforts of the hunters and gatherers in the exploitation of their resources in this area (including firing the vegetation), that it is difficult to refer to the Aborigines as passive food collectors. Similarly, in Tasmania, Hiatt (1968: 212, 219) suggests that the burning of the vegetation was used by the Aboriginal people there to convert rain forest vegetation into sclerophyll forest. Sclerophyll forest was a better food-producing environment and its encouragement by use of fire is suggested by Hiatt to be a deliberate action.

Throughout the southern South Australian region, burning of the vegetation appears to have been a common Aboriginal practice. One report from 1851 in a South Australian newspaper describes the problems the Port Lincoln land owners of the lower Eyre Peninsula had with the Aboriginal people 'burning the runs, which is [the] ...customary mode of hunting game ...'[11]. Another newspaper report from the same area in 1841 states: 'Independently of the danger which follows in the wake of a tribe of natives carrying fire-sticks through ripe grass, two or three feet high, they always set fire to scrubby places whenever a small patch is found, in order to hunt'.[12]

From the Adelaide area, another newspaper records that in 1839, an Aboriginal man named Williamy was charged with firing the grass in the park-lands. However, he was released due to lack of proof of malicious intent as it was considered by the Aboriginal people 'a necessary and laudable practice annually to burn off withered grass on their hunting-grounds to facilitate and hasten the growth of the young grass of which the native animals are so fond'.[13] Finlayson states that in the Adelaide Hills, during early February 1837: 'the natives had set fire to the long dry grass to enable them more easily to obtain the animals and vermin on which a great part of their living depends' (1902–3: 40–1). The regular burning off of the Lakes area of the Lower Murray region was apparently a sufficient threat to the local farmers for it to be reported in the Aboriginal Protector's Report of 1850. Here it was noted some land owners were offering incentives, in the form of goods, to Aboriginal people if they could get through the dry season without causing a serious bushfire[14]. These accounts and others indicate that the burning off of the vegetation in southern South Australia frequently resulted from Aborignal activity.

Although most accounts of firing are linked by observers to hunting practices, it is possible that Aboriginal people also used fire to open up the country by removing the understory to allow easier travelling and to promote the growth of grass for game species. Eyre remarked at length on the wide, open plains to the north of Adelaide. He appears to have been puzzled by them, particularly when there were remnants of large growths of timber nearby. In other places, the dense mallee type vegetation had pockets or grassy openings that to Eyre were like 'oases of the desert'. Eyre suggests that 'the plains found interspersed among the dense scrubs may probably have been occasioned by fires, purposely or accidentally lighted by the natives in their wanderings'... (1845, 1: 36). It is interesting to note that Eyre considered these grass plains to be an improvement on the dense *Eucalyptus dumosa* scrub as they provided feed for his horses and were easier to traverse. Many of the food-plant species discussed in this paper would benefit from the opening of the understory and the build-up of ash produced from regular burnings. Ellis discusses the role of fire in producing the open grasslands in the Adelaide area, stating that 'Certainly the area surrounding the present site of metropolitan Adelaide was the scene of deliberate Aborginal environmental manipulation, almost entirely dependent upon the use of fire' (1976: 113). Aboriginal people would not only have realised that they had an effect on the ability of the environment to produce food, but also appear to have actively used firing as a resource management tool.

Another important part of resource management was the replanting of tubers. This has been recorded from several parts of Australia. Gregory (1887: 131) states that the Aborigines of the west coast of Australia, 'invariably re-insert the head of the yams so as to be sure of a future crop'. Irvine (1970: 278) describes the practice in the above record as cultivation. Tindale (1977: 349) records a similar practice by the women of Flinders Island, Queensland. Batey (cited in Frankel 1982: 44) records that in Sunbury, Victoria, there existed numerous mounds which were caused by the 'accidental gardening' that occurred while gathering 'myrong' (*Microseris scapigera* as identified by Frankel). Batey suggested that Aboriginal people must have realised the effect they were having on the numbers of edible roots in the ground. Digging would have helped disperse and replant the undersized tubers for collecting in the future.

The evidence, both direct and by extension from similar environments, seems to point to Aboriginal people in southern Australia, taking much more active role in the use of their land and resources than earlier observers such as Cleland suggested.

Conclusion

Subterranean plant parts appear to have provided a varied and reliable source of food for the Aborigines of southern Australia. Certain species were also important for other hunting and gathering activities as they provided fibre for net bags and fishing nets. Other species were used as medicines, narcotics, sources of water and as pigment. Work with contemporary Aboriginal people from the Lower Murray and South East regions of South Australia is significantly increasing our knowledge of plant root usage. Although this type of information does not provide accurate quantitative use data, it can provide an indication of the value certain species could have had in the pre-European subsistence pattern. The view put forth by Cleland suggesting the insignificance of southern vegetation types in providing food is not supported by the evidence provided here. Cleland may have been restricted to his collection of data by the brief that only 'traditional' Aborigines could supply data on the uses of plants and plant-use. Data from contemporary Aboriginal sources cited in this paper suggest that this is incorrect. A fuller and more accurate view of Aboriginal use of the Australian environment may be gained by focusing on Aborigines as resource managers instead of as merely passive inhabitants of their landscape.

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Steve Hemming and myself on our field-trips. I am grateful to Robert Foster who assisted me in locating particular historical accounts. In preparing the data and ideas in this paper, I owe much to Steve Hemming. Comments on drafts of this paper were also received from Peter Sutton, Beth Gott and Peter Latz. Jenni Thurmer prepared the figure.

Endnotes

1. S.A. Museum specimen A68311. Cleland collection.

2. All references in this paper to contemporary Aboriginal descriptions and information comes from notes and tapes made on fieldtrips to the South East and the Lower Murray by Steve Hemming and myself at various times during 1986 and 1987. These are lodged in the S.A. Museum Archives.

3. S.A. Museum specimen A2084. Symes & Lewis

4. S.A. Museum specimen A1776. Advertiser Co. collection.

5. S.A. Museum specimen A1781. Source unknown.

6. S.A. Museum specimens A1778 & A27233. Thorup & Wait collection; S.A. Museum specimen A1779. Tate collection.

7. S.A. Museum specimen A1777. Phillipson collection.

8. S.A. Museum specimen A68304. Cleland collection.

9. Interview with Mr. G.W. Batty concerning early Victor Harbor history (6/11/86). S.J. Hemming & P.A. Clarke.

10. Transactions of the Statistical Society, *South Australian* 11 Jan. 1842, pp. 11–12.

11. *Observer* 31 May 1851, page 5.

12. *Adelaide Chronicle and S. Aust. Literacy Record* 22 Dec. 1841, page 3.

13. *South Australian Gazette and Colonial Record* 9 March 1839, page 7.

14. Aboriginal Protectors Report *South Australian Gazette and Colonial Record* 20 April 1850, page 4.

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AMENDED TYPE LOCALITIES OF FIVE SPECIES OF SPIDERS (ARACHNIDA: ARANEAE) DESCRIBED BY H. R. HOGG IN 1905

Lycosa gilberta, L. molyneuxi, L. phyllis, L. stirlingae and *Dolomedes habilis* were described by H. R. Hogg in 1905 from specimens sent to England from the South Australian Museum. Type specimens are lodged in the South Australian Museum, with the exception of *Lycosa stirlingae*, the whereabouts of which is unknown (McKay 1985). In the same work, McKay also stated the whereabouts of three female *Lycosa habilis* types as unknown, the generic change having been made by Rainbow (1911). Recently two of these types were located in the South Australian Museum collection and have been found to be *Dolomedes*.

The vials contain labels giving the locality as 'Gilbert River', or 'Gilbert River, Riverina', the state being omitted. Hogg, in his introduction, stated that they were 'chiefly from the north side of the River Murray in New South Wales'. This locality has not been questioned by subsequent revisers (Rainbow 1911; McKay 1975, 1985), although both authors had appeared to be in doubt over the type locality of *Lycosa gilberta*; Rainbow's being 'Australia', while McKay (1985) recorded the locality as 'Gilbert River, Riverina, S.A.', all other type localities of the species above being given as from New South Wales.

During a routine check of localities I found there was a Gilbert River near Riverton in South Australia. Knowing also that A. Molyneux, the collector of the above material, had sent specimens to the South Australian Museum from nearby Tanunda, my suspicions were aroused. From further enquiries I learnt that A. Molyneux had lived and worked in that area of South Australia. Subsequent searches of the relevant maps, the Gazetteer and enquiries to both the South Australian Geographical Names Board and the Geographical Names Board of New South Wales failed to show the existence of a Gilbert River in the Riverina of New South Wales.

It is postulated that 'Riverina' on the labels is a misspelling of Riverton. This small town is situated on the Gilbert River, a tributary of the Light River in South Australia. All type specimens referred to above are here considered to have been collected from Gilbert River, Riverton, South Australia. (34°10'S, 138°45'E).

As McKay (1975) considered the 'Gilbert River area is of special significance in the clarification of species within the "leuckartii" group', this new light on the type locality should provide for more fruitful research in the future on that group of wolf spiders.

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GENERA *NABIS* LATREILLE AND *STENONABIS* REUTER (HEMIPTERA: NABIDAE) IN AUSTRALIA

N.G. STROMMER

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STROMMER, N.G. 1988. Genera *Nabis* Latreille and *Stenonabis* Reuter (Hemiptera: Nabidae) in Australia. *Rec. S. Aust. Mus.* 22(2): 79-93.

Descriptions of three species of *Nabis* Latreille and seven species of *Stenonabis* Reuter are presented. Two new species, *Stenonabis henriettae* sp. nov. and *Stenonabis morningtoni* sp. nov., are described and illustrated. A key to *Nabis* and *Stenonabis* species is provided.

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First investigations and preliminary descriptions of the Australian species of *Nabis* Latreille and *Stenonabis* Reuter were done by Dr I.M. Kerzhner (1969). His work was mainly based on the material of the South Australian Museum, Adelaide (SAMA).

Additional material for the present paper was supplied by the Queensland Museum, Brisbane (QM); Entomology Department, Queensland University, St Lucia (EUQ); Australian National Insect Collection, Canberra (ANIC); Western Australian Museum, Perth (WAM); Australian Museum, Sydney (AM); Museum and Art Galleries of the Northern Territory, Darwin (NTM); Zoological Museum der Humbold-Universität, Berlin, DDR (ZBM).

Other abbreviations of the Museums: AMNH — American Museum of Natural History, New York, USA; BMNH — British Museum Natural History; ZIN — Zoological Institute, Leningrad, USSR.

The common species *Nabis biformis* Bergroth, previously known only from New Zealand (Kerzhner 1969), is here recorded from Australia. The macropterous form of *Nabis fraternus* Kerzhner is recorded and described. The female genitalia in *Nabis biformis* Bergroth and *Nabis fraternus* Kerzhner are illustrated for the first time. Both macro- and brachypterous forms of these two species are redescribed with the use of the additional material from other Museums in Australia. *Nabis kinbergii* Reuter, previously misidentified in Australia as *Nabis capsiformis* Germar (Kerzhner 1981, Woodward 1982, Woodward & Strommer 1982) is redescribed.

Out of 11 species of *Stenonabis* known in Australia so far, 2 species are newly described, 1 species (*S. geniculatus* Erichson) is described fully in the first time, 4 other species (*S. imitator* Kerzhner, *S. roseus* Kerzhner, *S. nitidicollis* Kerzhner, *S. darwini* Kerzhner) are redescribed with the use of additional material; the remaining 3 species (*S. communis* Kerzhner, *S. robustus* Kerzhner, and *S. australicus* Kerzhner) are presented in Kerzhner (1969). New illustrations are given for the female genitalia in *Stenonabis geniculatus* Erichson, and male genitalia in *Stenonabis roseus* Kerzhner, *Stenonabis darwini* Kerzhner and *Stenonabis nitidicollis* Kerzhner. A previously unrecorded, brachypterous form of *Stenonabis nitidicollis* Kerzhner is described.

Genus **Nabis** Latreille, 1802

Type-species: *Cimex vagans* Fabricius, 1787 = *Cimex ferus* Linnaeus, 1758, designated by Westwood, 1840.

Body rather narrow, with sides parallel or slightly widening in middle of abdomen, especially in females. Head margins behind eyes nearly parallel; ocelli set rather wide apart. Antennae without dark rings; legs often with dark patches or short lines on femora, but without dark or black rings. Pronotum without punctation and with brown pattern on fore lobes, comprised of series of irregularly-shaped and sized brown patches. Connexivum yellowish, very rarely with dark patches, separated underneath from abdominal sternites by a groove and elevated in middle part of abdomen in a cylindrical form.

Paramere variously shaped, but most often with body of blade semicircular; aedeagus with a variable number of sclerites; vagina symmetrical or asymmetrical, with 1-2 parietal glands.

Macropterous and brachypterous forms, but hemelytra nearly always reaching end of abdomen. The genus includes subgenera *Nabis, Tropiconabis* and *Reduviolus,* differentiated from one another by the form of the genitalia; subgenus *Reduviolus* is not represented in tropical areas (Kerzhner 1981).

At the suggestion of Dr I.M. Kerzhner, the two Australian species of the genus *Nabis* have been placed in the new sub-genus *Australonabis.* Besides these two closely related species (*N. biformis* and

N. fraternus) discussed below, the subgenus includes *N. larvatus* Kerzhner from New Caledonia.

Key to Australian Species of *Nabis*

1 — Always macropterous. Length of fore femora less than 2.3 mm. Aedeagus with 3 sclerites. Vagina with a dorsal sack covering base of common overduct (Subg. *Tropiconabis*) .... *Nabis kinbergii* Reuter
— Mostly brachypterous. Length of fore femora 2.5-3.1 mm. Aedeagus with numerous similar sclerites in basal part and with 4 or 5 dissimilar sclerites in apical part. Vagina without dorsal sack (Subg. *Australonabis*) 2

2 — Aedeagus with 5 sclerites in apical part; vagina symmetrical, with rounded or flat base; walls of vagina without sclerotized bands .... *Nabis biformis* Bergroth
— Aedeagus with 4 sclerites in apical part. Vagina slightly asymmetrical, with cone shaped base and sclerotized bands in right wall .... *Nabis fraternus* Kerzhner

Australonabis subgen. nov.

Nabis biformis Bergr.-Gruppe': Kerzhner, 1969: 346.

Type-species: *Reduviolus biformis* Bergroth, 1927.

Species with pronounced wing reduction: in most specimens of *N. biformis* and in all known specimens of *N. fraternus,* hemelytra about twice the length of scutellum, without membrane, while *N. larvatus* is apterous. Disc of paramere nearly semicircular, with pointed apex; aedeagus with a row of numerous similar sclerotized plates in basal half and some additional sclerites in apical half (4-5); vagina without sack covering its opening, with or without sclerotized bands in the wall.

Distinguished from the other subgenera by the unique sclerotized structures in the basal part of the aedeagus.

Nabis biformis (Bergroth)
(Figs 1a, b, c, d)

Reduviolus biformis Bergroth, 1927: 681.
?*Nabis lineatus* Hutton, 1904, 372 pp. (non Dahlbom, 1851).
Nabis biformis Kerzhner, 1969: 346-347, Fig. 43.

Macropterous form

Head: pale yellow with dark areas behind eyes and ocelli, pale brown longitudinal stripe between ocelli and eyes and broad dark brown median stripe beneath; clypeus brownish. Antennifers brown, antennal segments brownish yellow, segment II with brown apex; rostral segments I and II pale yellow beneath, brown dorsally, segments III and IV brownish. Eyes and ocelli reddish brown. Short shiny yellow hairs, becoming denser behind eyes and ocelli and a few longer ones dorsally; medium-sized and rather dense hairs beneath. Sides behind eyes parallel.

Thorax: pronotum yellowish with dark brown markings: broad median longitudinal stripe becoming narrower on collar and hind lobe; brown pattern on fore lobe and additional pale brown parallel stripes on each side of median one on hind lobe. Small dark dots on collar and hind lobe. Pronotum as long as head, laterally distinctly sinuate, with base about 2.5 or more times broader than apex; fore lobe slightly convex, 1.2 times longer than hind lobe, latter strongly declivous, forming an angle with fore lobe. Scutellum large, wider than long, with pointed apex, dark brown, with 2 yellow rounded patches on sides. Hemelytra reaching end of abdomen; corium and clavus covered with short pale hairs, corium with prominent yellow veins and dark clavus; membrane hyaline, transparent, with distinctive dark veins. Coxae yellowish with dark brown patches basally, both anteriorly and posteriorly; femora pale yellow with touch of pinkish tones and brown markings: 2 rows of short transverse parallel stripes (15-16) laterally and irregular row of dots dorsally; tibiae yellow with brown apices and bases. Legs covered with pale, medium-sized hairs, becoming dense ventrally and with sparse long ones laterally and dorsally; tibiae with 2 rows of dark, very small teeth ventrally.

Abdomen: brownish beneath, covered with short decumbent hairs.

Brachypterous form

Head: as in macropterous form.

Thorax: hind lobe of pronotum pale yellow with indistinct additional stripes on sides of median one; punctuation on collar and hind lobe of pronotum indistinct; pronotum a little shorter than head, at sides slightly sinuate behind middle, at base 2 or less times as broad as at apex; hind lobe not forming angle with fore lobe, 2.5 times shorter than fore lobe. Scutellum smaller than in macropterous form, a little wider than long. Hemelytra short, more than twice as long as scutellum, without membrane; outer margin of corium incurved posteriorly, apical angle somewhat distant from lateral margin of abdomen, apical margin obliquely straight, forming right angle with apical margin of outer corium.

Abdomen: brown with yellow patches on connexivum beneath or yellow with brown median stripe dorsally.

Male genitalia: parameres large, with body of blade broad and apex curved (Fig. 1a, b); aedeagus

with numerous similar sclerites (plates) in basal part and with 5 dissimilar sclerites in apical part, with 2 of them dentate (Fig. in Kerzhner 1969).

Female genitalia: vagina symmetrical, with rounded or flat base; base of vagina without sclerotized bands; parietal glands asymmetrical in shape and unequal in size, with their posterior parts (loops) lying on dorsal side and anterior loops on ventral side of vagina; right gland larger, with dorsal and ventral loops of equal size, left gland much smaller, with ventral loop much larger than dorsal one (Fig. 1c, d).

Type material

Syntypic series from New Zealand, examined by Kerzhner (1969) — 1 ♀, macropterous, Henderson, Auckland, 14 Mar. 1922, ad Lizzia (Albizzia?), Myers; 1 ♀, brachypterous, Herne Bay, Auckland, 24 Feb. 1919, G. Howers; 1 ♀, brachypterous, Whangarei, 18 Feb. 1923, J.G. Myers; 1 ♀, brachypterous, N. Auckland, Peu.(?), T.R. Harris (all BMNH).

Other material examined

Tasmania: 1 ♂, brachypterous, 7 mls W. Rosebury, 18 Feb. 1963, I.F.B. Common & M.S. Upton (ANIC); 1 ♂, brachypterous, Lake Dobson Rd, 8 Feb. 1955, T.E. Woodward, bracken fern (QM); 1 ♀, macropterous, Devonport, 16 Feb. 1967, G. Monteith (QM); 1 ♀, brachypterous, Waratah, A.M. Lea, former paratype of *Nabis fraternus* Kerzhner; New South Wales: 1 ♂, brachypterous, Barrington Tops, via Salisbury, 28–30 Dec. 1965, T. Weir (QM); 1 ♀, macropterous, 1 ♀, brachypterous, Mt. Dromedary, nr Narooma, 2100 ft., 4 Feb. 1969, M.S. Upton, Taylor, Cardale (ANIC); 3 ♀, brachypterous, Pilot Hill, Bago, Forest below (?), 12 Mar. 1957 (ANIC); Australian Capital Territory: 1 ♂, brachypterous, Blundells, 31 Jan. 1970, E.F. Riek (ANIC); Victoria: 1 ♂, brachypterous, Frankston, Melb., 17 Jan. 1955, T.E. Woodward (QM); 2 ♀, brachypterous, Beech Forest, 4? 1937, R.V. Fyfe (ANIC).

Measurements

In Kerzhner (1969).

Remarks

N. biformis was described from New Zealand by Bergroth (1927) from 3 females, but he did not examine the genitalia. Kerzhner (1969) re-examined supposedly the same syntypes together with additional material from New Zealand and provided measurements both macro- and brachypterous forms and drawings of the male genitalia. The above description of the macro- and brachypterous forms together with the description of the female genitalia are prepared from material examined from various locations in Australia.

Examination of the material from Australia shows that *N. biformis* is a rather common species widely distributed in New South Wales, Australian Capital Territory, Victoria and Tasmania. The species is very similar in appearance and in most measurements to *N. fraternus* Kerzhner, and distinguished from the latter by its longer legs, antennae and rostrum, but it is very difficult to separate the two species without comparing their genitalia. The male genitalia of *N. biformis* differ from those of *N. fraternus* by the presence of 2 additional dentate sclerites in the distal part of the aedeagus, by the noticeably broader body of the blade of the paramere and its curved apex. The difference in the female genitalia is not as marked as in the male, but the vagina of *N. biformis* lacks the sclerotized bands in the right wall and has a rounded base (ovally protruding in *N. fraternus*).

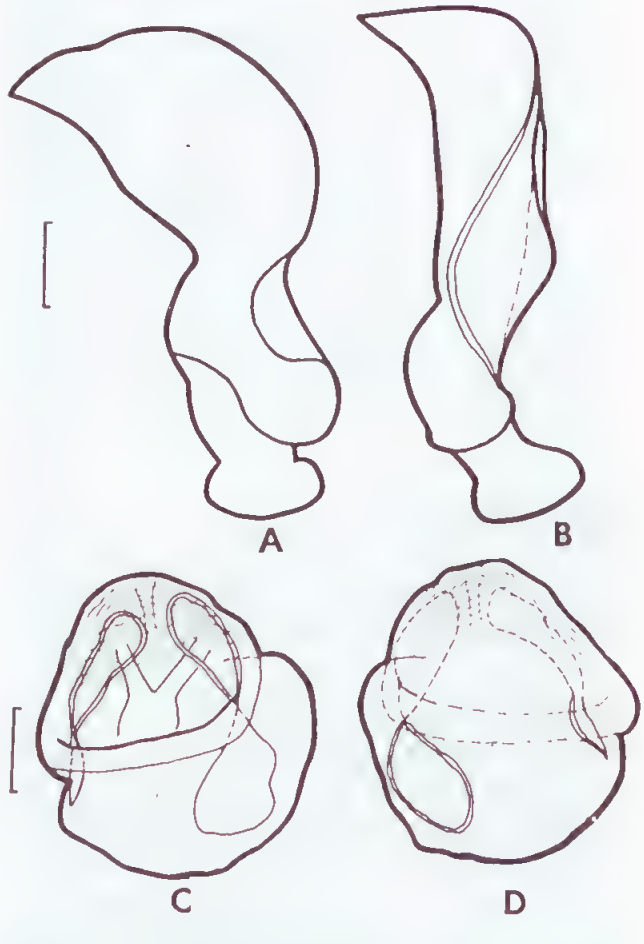

FIGURE 1. *Nabis biformis* Bergr.: a — paramere, lateral view; b — the same, from below; c — vagina, view from above; d — the same, from below.

Nabis fraternus Kerzhner
(Figs 2a, b, c, d)

Nabis fraternus Kerzhner, 1969: 347–349, Fig. 44.

Macropterous form

Head: pale yellow with brownish areas in front of and behind eyes; longitudinal median stripe pale brown between ocelli and eyes, fading toward base of clypeus; broad median stripe beneath; clypeus and antennifers dirty yellow. Antennae brownish yellow, segment II with brown apex; rostral segments I and II pale yellow ventrally, brown dorsally; segments III and IV brownish. Eyes shiny, silvery; ocelli yellow with red rim.

Thorax: pronotum dirty yellow with pale brown median longitudinal stripe becoming narrower on hind lobe and with indistinct brown pattern on fore lobe; small dark dots on collar and hind lobe. Pronotum a little longer than head, at sides distinctly sinuate behind middle, at base about 2.3 times broader than apex. Fore lobe nearly flat, 1.3 times longer than hind lobe, latter strongly declivous, forming an angle with fore lobe. Scutellum yellow with wide dark brown median stripe becoming narrow toward apex and with irregular brown areas basally and laterally. Coxae yellow with brown bases; femora pinkish yellow with brown markings: 2 rows of short transverse parallel stripes (12–13) and an irregular row of dark brown dots dorsally; tibiae yellow with brown apices, fore tibiae with 2 dark rings on basal 1/2, all tibiae with 2 longitudinal rows of small teeth ventrally. Hemelytra dirty yellow, reaching end of abdomen or little shorter; corium with prominent yellow veins and small dark dots basally and on clavus; membrane hyaline, transparent, with indistinct veins; corium and clavus covered with short decumbent hairs.

Abdomen: yellowish beneath, with brown median stripe; connexivum brownish, with pinkish tones.

Brachypterous form

Head: as in macropterous form, but with dark brown eyes and ocelli; brownish median stripe between eyes and ocelli widening toward base of clypeus.

Thorax: pronotum with dark brown median stripe not narrowing on hind lobe and less prominent punctation on collar and hind lobe; fore lobe convex, raised above collar, hind lobe not forming angle with fore lobe. Scutellum smaller than in macropterous form, a little longer than wide. Legs without pinkish tones, fore tibiae without visible rings on basal 1/2. Hemelytra very short, dirty yellow, without visible dots on base of corium and clavus, more than twice as long as scutellum; membrane absent.

Abdomen: dark brown beneath, with yellow median stripe, yellowish brown dorsally, with brown median longitudinal stripe and yellow connexivum.

Male genitalia: paramere large, with relatively narrow body of blade and slightly curved apex (Figs 2a, b); aedeagus with 4 dissimilar sclerites in apical part and numerous similar plates in basal part (Fig. in Kerzhner 1969).

Female genitalia: vagina slightly asymmetrical, with cone shaped base and sclerotized bands on right wall; parietal glands asymmetrical and of unequal size; left gland much smaller, with its ventral loops larger than dorsal ones (Fig. 2c, d).

Type material

Holotype — 1 ♂, brachypterous, Tasmania, Waddamana, R. Ouse, below outlet, 20 Feb. 1936, Parker (BMNH); paratypes — 3 ♀, brachypterous, the same location (BMNH, ZIN, not examined), but the fourth paratype, ♀, brachypterous, Tasmania, Waratah, A.M. Lea (SAMA), has been examined and found to be a specimen of *Nabis biformis*.

Other material examined

New South Wales: 1 ♀, macropterous, Byron Bay, 25 Nov. 1971, N. Monroe (EUQ); Tasmania: 1 ♀, brachypterous, Miena, Great L., 17 Feb. 1955 (EUQ); 1 ♂, brachypterous, Duck Cr., nr Dee, 12 Feb. 1955, T.E. Woodward (EUQ).

Measurements

Macropterous form: head length 1.40, preocular part 0.70, postocular 0.25, length of eyes 0.45, width across eyes 0.90, interocular distance 0.40, width in front of eyes 0.45, behind eyes 0.60. Length antennal segments I 1.10, II 1.75, III 1.75, IV 1.45; length rostral segments II 1.10, III 1.0, IV 0.45. Median length of pronotum 1.50, collar 0.25, fore lobe 0.70, hind lobe 0.55; anterior width 0.70, posterior width 1.60; width of scutellum 0.90, length 0.80. Length fore femora 2.60, tibiae 2.00, mid femora 2.25, tibiae 1.85, hind femora 3.35, tibiae 3.60. Length of body 8.7 mm, width across hemelytra 1.7 mm (♀ from material examined).

Brachypterous form: in Kerzhner (1969).

Remarks

Nabis fraternus Kerzh. is a rather rare species known so far from New South Wales and Tasmania and is represented both by macro- and brachypterous forms. It is very similar to *N. biformis* and is separated most convincingly by the construction of the genitalia.

Subgenus **Tropiconabis** Kerzhner, 1968

Type-species (original designation): *Nabis capsiformis* Germar, 1938.

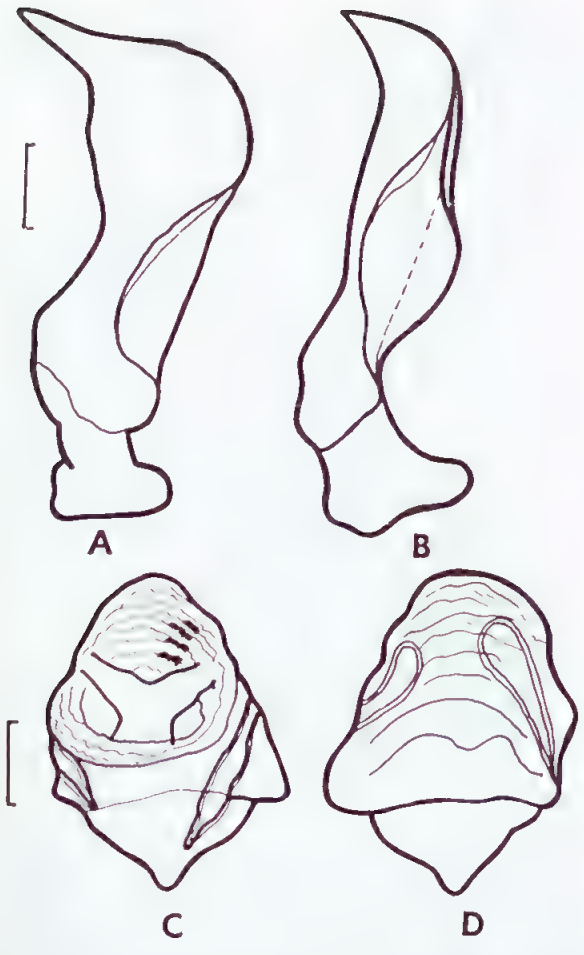

FIGURE 2. *Nabis fraternus* Kerzh.: a — paramere, lateral view; b — the same, from below; c — vagina, view from above; d — the same, from below.

Macropterous species, with wings extending well beyond end of abdomen. Paramere small, with semicircular blade; aedeagus with two larger sclerites pointing in opposite directions, and third, smaller one; vagina with oval sack covering base of common oviduct dorsally, with (*N. capsiformis*) or without (*N. kinbergii*) division on left and right parts. The subgenus is represented in tropics and subtropics and includes, besides *N. capsiformis* and *N. kinbergii, N. maoricus* Walker (New Zealand) and *N. consimillis* Reuter (Ecuador, Peru, Galapagos Is). In Australia there is only one species, *N. kinbergii.*

Nabis kinbergii Reuter
(Figs 3a, b, c)

Nabis kinbergii Reuter, 1872: 90 (part)
Sastrapada nigrolineata Distant, 1920: 159 (syn. with *N. kinbergii* by Kerzhner, 1981).
Nabis nigrolineata: Cheesman, 1927: 158
Nabis tasmanicus Remane, 1964: 257 (syn. with *N. nigrolineatus* by Kerzhner 1969).
Nabis nigrolineatus: Kerzhner, 1969: 354–355
Tropiconabis nigrolineatus: Kerzhner, 1968: 852; Woodward, 1982: 143–146.
Nabis (Tropiconabis) kinbergii: Kerzhner, 1981: 294–296.
Nabis capsiformis: auct, non Germar: non Woodward & Strommer, 1982: 306.

Description

Head: dull, with shiny clypeus and antennifers, yellow with dark brown areas in front of and behind eyes and with median longitudinal stripe between ocelli and eyes, broadening toward clypeus; antennifers and base of clypeus brownish. Head beneath brown greyish or greyish white, or head entirely pale yellow with darkish areas in front of and behind eyes and antennifers; pale beneath. Eyes and ocelli shiny, reddish brown, yellowish brown or silvery brown. Antennae brownish yellow or yellowish brown with segment I yellow ventrally. Rostral segment I yellow with brown base, segment II and III yellowish brown, yellow ventrally, segment IV with brown apex. Head covered with short pale hairs dorsally and on antennae and rostrum, becoming longer and denser ventrally on clypeus and rostral segment I.

Thorax: pronotum dull, yellow, dirty yellow or pale greyish yellow, with dark brown markings: brown median longitudinal stripe, becoming much narrower on collar and hind lobe, brown pattern on fore lobe and very indistinct additional pale brown stripes, two on each side of median one; where pronotum very pale, only pattern on fore lobe visible. Scutellum yellow, orange yellow or pale yellow with broad brown or darkish median stripe reaching or not reaching its apex. Pronotum longer than head, at sides slightly sinuate behind middle, at base ♂ 1.8–2.1, ♀ 2.2–2.3 times broader than at apex. Fore lobe slightly convex; hind lobe slightly raised above fore lobe. Coxae yellow or pale yellow; legs entirely yellow or brownish yellow; sometimes fore femora with row of short horizontal parallel brown stripes externo-laterally; fore and mid tibiae with 2 rows of very small brown teeth ventrally. Hemelytra translucent, sometimes transparent, dirty yellow or pale yellow to whitish, exceeding end of abdomen by up to 1/2 their length; corium with prominent yellow or pale yellow veins, these sometimes with irregular brown markings; clavus brownish, dirty yellow or pale yellow with brown apex, with short decumbent hairs; membrane with brownish veins. Ventrally thorax yellow with dark brown meso- and meta-sternum and with dark brown longitudinal stripe on mesopleura becoming much narrower on metapleura; sometimes entirely pale yellow, without brown markings or with very pale ones.

Abdomen: yellowish brown with yellow connexivum and median stripe, or sometimes entirely pale yellow with or without median stripe, covered with small decumbent hairs.

Male genitalia: paramere with inner margin angularly incised at junction of shank and blade, apex of blade curved (Fig. 3a); aedeagus with 3 sclerites, one of them large, next to very small one, pointing in same direction, third sclerite of medium size, pointing in opposite direction to other two (Fig. 3b).

Female genitalia: vagina entirely membranous, thin-walled, without division into right and left lobes (in contrast to *N. capsiformis,* Fig. 3c).

Type material

Lectotype of *kinbergii* (designated by Kerzhner, 1981) 1 ♀, 'Sydney', Kinberg, Naturhistoriska Riksmuseet, Stockholm; Holotype of *nigrolineata,* ♀, Central New Caledonia, 17.XI.1914, P.D. Montague (BMNH); Holotype of *tasmanicus,* ♂, Tasmania, King I., Lea, Zool. Mus., Helsinki University, paratypes from Bismarck Is, Australia and Fiji (the same Museum) and in Dr R. Remane's collection (Mahrburg/Lahn, BRD).

Other material examined

Northern Territory: 1 ♂, Magela Cr.; Queensland: 1 ♂, Lake Idamea, Glenormiston St, 1 ♀, Normanton, 1 ♂, Mornington, 1 ♀, Cunnamulla; New South Wales: 1 ♀, Upper Williams R.; South Australia: 1 ♂, 1 ♀, L. Eyre, 1 ♂, 1 ♀, Wirreanda Cr., 1 ♂, nr Victory Well, Everard Pk., 1 ♂, Athelstone, 1 ♂, 1 ♀, Mt. Lofty, 1 ♀, Coward Spring, 1 ♂, Jirry's Well; Fiji: 1 ♀; New Hebrides (now Vanuatu), 1 ♂, 1 ♀ (specimens from various collections in Australia).

Measurements

Head length ♂ 1.00–1.05, ♀ 1.05–1.10, preocular part ♂, ♀ 0.50–0.55, postocular part ♂ 0.15–0.20, ♀ 0.20, length of eyes ♂ 0.30–0.35, ♀ 0.35; width across eyes ♂ 0.70–0.80, ♀ 0.75–0.80, interocular distance ♂ 0.35–0.37, ♀ 0.35–0.40, width in front of eyes ♂ 0.40, ♀ 0.40–0.45, behind eyes ♂ 0.50–0.55, ♀ 0.55, width of eyes ♂ 0.17–0.20, ♀ 0.22. Length antennal segments I ♂ 1.05–1.20, ♀ 0.90–1.05, II ♂ 1.60–1.80, ♀ 1.45–1.80, III ♂ 1.65–1.70, ♀ 1.50–1.60, IV ♂ 0.90–1.00, ♀ 0.90. Length rostral segments II ♂ 0.85, ♀ 1.00, III ♂ 0.85, ♀ 1.00, IV ♂ 0.40, ♀ 0.40–0.45. Median length of pronotum ♂ 1.10–1.35, ♀ 1.30–1.40, collar ♂, ♀ 0.20, fore lobe ♂ 0.50, ♀ 0.50–0.55, hind lobe ♂ 0.45–0.60, ♀ 0.60–0.65; anterior width ♂, ♀ 0.70, posterior width ♂ 1.30–1.50, ♀ 1.55–1.60. Length of scutellum ♂ 0.55, ♀ 0.60, width ♂ 0.65–0.70, ♀ 0.75. Length fore femora ♂ 2.10–2.15, ♀ 2.00–2.05, tibiae ♂ 1.60–1.75, ♀ 1.70–1.75; mid femora ♂ 1.85, ♀ 1.75–2.10, tibiae ♂ 1.75, ♀ 1.80; hind femora ♂ 2.75, ♀ 2.80–3.10, tibiae ♂ 3.40–3.50, ♀ 3.25–3.55. Length of body ♂ 7.0–8.7 mm, ♀ 8.5–9.7 mm; width across hemelytra ♂ 1.4–1.75, ♀ 1.6 mm (examined material).

Remarks

In Australia, New Zealand and some islands in the Western Pacific, *N. kinbergii* replaces another widespread and very similar species *N. capsiformis* Germar (Kerzhner 1968, 1969, 1981), with which it had been confused in Australia for years (Woodward 1982, Woodward & Strommer 1982). Detailed examination of the male and female genitalia of large numbers of specimens (all previously referred to *N. capsiformis*) from different regions of Australia, undertaken by Dr Kerzhner, Dr T.E. Woodward and by the present author, convince us that *N. kinbergii* is one of the most common and widespread species of *Nabidae* in all parts of Australia, including Tasmania.

The species was first recognized as distinct from *N. capsiformis* by Remane (1964), who described it as *N. tasmanicus.* Later it was found that *Sastrapada nigrolineatus* Distant from New Caledonia is not a junior synonym of *N. capsiformis,* but a senior synonym of *N. tasmanicus.* However, an earlier name *N. kinbergii* Reuter, based on a female from Sydney and two females from Buenos-Aires, had been synonymized with *N. capsiformis* until Kerzhner (1981) designated the specimen from Sydney as lectotype, thus making *N. nigrolineata* a synonym of *N. kinbergii*; however, the females from Buenos-Aires belong to *N. capsiformis.*

N. kinbergii is very similar in appearance and in most measurements to *N. capsiformis.* Comparison of *N. kinbergii* with the description given by Kerzhner (1981) of *N. capsiformis* shows no significant differences. However, there are obvious differences in the male and female genitalia, best seen in a comparison of the aedeagi which have quantitative differences: the absence of the small hook (sclerite) in *N. capsiformis*; the parameres in *N. capsiformis* are concavely and more shallowly excavated than in *N. kinbergii.* The vagina in *N. capsiformis* is distinctly divided into smaller, thick-walled right lobe and much larger membranous left lobe, while in *N. kinbergii* the vagina consists only of the thin-walled lobe (Remane 1964, Woodward 1982).

Genus **Stenonabis** Reuter, 1980

Type-species (original designation): *Coriscus annulicornis* Reuter, 1882.

Body more or less elongated. Head behind eyes with approximately parallel sides. Ocelli set wide.

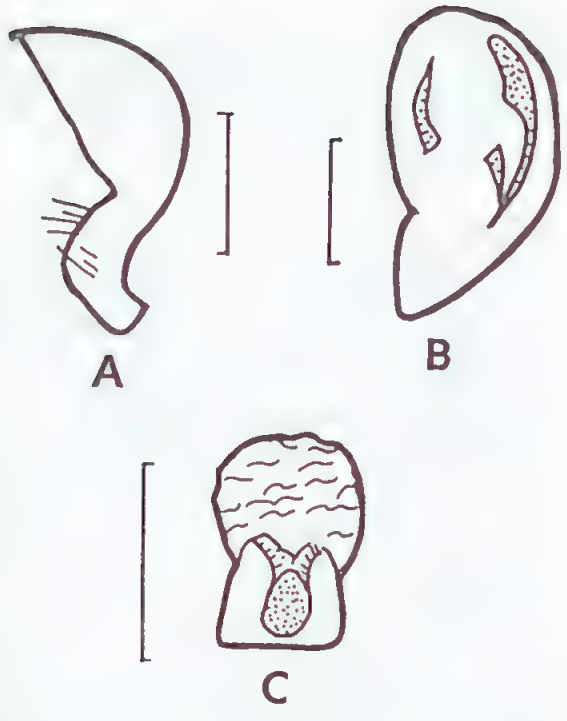

FIGURE 3. *Nabis kinbergii* Reut.: a — paramere; b — aedeagus; c — vagina.

Antennae and legs long, often with dark rings. Collar and hind lobe of pronotum with prominent punctuation; fore lobe with characteristic pattern of brown patches. Connexivum seen from below not separated from abdominal segments by impression or groove, often with dark patches.

Parameres of diverse shape, often with complex outlines; aedeagus with various set of sclerites in shape of hooks, plane or dentate plates, etc. Vagina of various shape, more often asymmetrical, with two parietal glands.

Majority of species macropterous, some represented both by macro- and brachypterous forms; hemelytra sometimes considerably reduced.

The genus is widely distributed in Australia, except for the western regions.

Key to the Australian Species of *Stenonabis*

1 — Dark median longitudinal stripe on hind lobe of pronotum more or less widening toward base; hind femora dark apically 2
— Dark median longitudinal stripe on hind lobe of pronotum usually not widening toward base; if so widening (*S. roseus*), all femora not dark apically 3

2 — Outer vein of corium (R+M) and cubital vein (Cu), at least distally, pink or pinkish or hemelytra short; total length of body 6.0–7.6 mm . ..... *nitidicollis* Kerzhner
— Veins of corium without pink tones; macropterous; total length of body 7.75–9.60 mm .. .. *darwini* Kerzhner

3 — All femora yellowish, without dark tones 4
— Hind or mid femora dark or black 5

4 — Narrow and long, with yellow or yellowish pink body and outer vein of corium bright pink or pink, at least distally; macropterous; total length of body 9.5–10.1 mm, width across hemelytra 1.95–2.15 mm .... *roseus* Kerzhner
— Broader, with derty yellow body and veins of corium without pink tones; macropterous or brachypterous; total length of body 8.0–9.4 mm, width across hemelytra 2.0–2.9 mm .... *robustus* Kerzhner

5 — Dark median longitudinal stripe on pronotum uniformly wide for its whole length 6
— Dark median longitudinal stripe wider on collar and fore lobe and noticeably narrower on hind lobe of pronotum 7

6 — Pronotum with additional stripes on each side of median stripe, very indistinct on hind lobe of pronotum; brachypterous; total length of body 7.0–7.1 mm ..... *geniculatus* Erichson
— Pronotum with additional stripes on each side of median stripe, distinct on hind lobe of pronotum; macropterous; total length of body (♂) 8.0 mm ..... *morningtoni* sp. nov.

7 — Whole body, including head and clypeus, dull; total length 7.5–7.9 mm .... *australicus* Kerzhner
— Body not entirely dull 8

8 — Hind lobe of pronotum more shiny than fore lobe; extreme lateral stripe on hind lobe broad, unbroken; one of two others, closest to median stripe, reduced to small patch at base of pronotum; total length of body 6.7–7.3 mm .... *communis* Kerzhner
— Hind and fore lobes of pronotum equally shiny, the rest of body dull, all three additional stripes on each side of hind lobe noticeable, but nearly always broken 9

9 — At least radio-medial vein (R+M) of corium distally pink or pinkish; eyes reddish brown; blade of paramere relatively narrow, with a large hook; vagina asymmetrical; total length of body 7.0–8.6 mm ..... *imitator* Kerzhner
— Radio-medial vein of corium without pink or pinkish tones; eyes pinkish brown; blade of paramere broad, with relatively small hook; vagina symmetrical; total length of body 7.75–8.25 mm ..... *henriettae* sp. nov.

Stenonabis henriettae sp. nov.
(Figs 4a, b, c, d, e, f)

Description

Head: slightly shiny except very shiny vertex, clypeus and median stripe on collar; pale yellow, with pale brown stripe between eyes dorsally, widening toward base of clypeus, eyes and ocelli reddish brown, clypeus and antennifers brownish; head beneath dirty yellow. Antennal segments I and II, except brown apex, dirty yellow, segments III and IV yellowish brown. Rostral segments yellowish brown dorsally and yellow ventrally. A few hairs dorsally, shorter sparse hairs ventrally and very short dense ones behind eyes dorsally.

Thorax: pronotum yellow, with pale brown median stripe, becoming narrower on hind lobe; two additional parallel brownish stripes on collar laterally and brownish pattern on fore lobe; three brownish broken parallel stripes on both sides of median one on hind lobe.

Collar and hind lobe of pronotum with distinct punctation; collar with shallow transverse impression in middle; demarcation between fore and hind lobes distinct; anterior margin of pronotum slightly concave, posterior margin nearly straight, lateral margins shallowly concave between lobes, fore lobe slightly raised above collar; hind lobe slightly raised above fore lobe; fore lobe 1.2–1.5 times shorter than hind lobe. Scutellum dull, dirty yellow with dark brown median stripe not reaching apex and with shallow impression in middle. Legs brownish yellow. Coxae and trochanters stramineous; fore and mid femora pale yellow dorsally, brownish with irregular yellow patches ventrally; hind femora stramineous except brown distal one-fifth; all tibiae brownish yellow, brown distally. Hemelytra brownish with yellow veins and yellow areas between them, with brown apex; clavus with two rows of indistinct punctures along basal half of claval suture; membrane yellow, translucent, with brown veins and without closed cells (rarely with 1 or 2); hemelytra surpassing apex of abdomen. Ventrally thorax brownish, meso- and metapleura with dark brown stripe laterally, meron and metepisternum yellow.

Abdomen: yellow beneath with brown median and lateral longitudinal stripes on each side of median one; genital segment brown, with long light hairs. Abdomen in females dull, in males very shiny, covered with short yellow hairs.

Male genitalia: paramere of medium size, with wide blade, prominent hook laterally and small tooth on top of blade (Figs 4a, b, c); aedeagus large, with number of differently shaped sclerites (Fig. 4d).

Female genitalia: Vagina small, symmetrical, thin-walled, with light transverse wrinkles and large parietal glands (Figs 4e, f).

Type material

Holotype — 1 ♂, North Queensland, Henrietta Cr., Palmerston Nat. Park, 23 Jan. 1970, G.B. Monteith (QM); Paratypes — 3 ♀, same data as for holotype (QM).

Other material examined

North Queensland: 1 ♂, 1 ♀, Iron Range, Cape York Pen., 26 May–2 June 1971, B.K. Cantrell; 1 ♂, Iron Range, Middle Claudie R., 19–20 Oct. 1974, M.S. Moulds; 1 ♂, Iron Range, 16–23 Nov. 1965, G. Monteith; 1 ♂, Dividing Range, Cape York Pen., 15 km W. of Captain Billy Cr., 142°45′ E., 11°40′ S., 4–9 July 1975, G. Monteith (all specimens QM).

Measurements

Head length ♂ 1.05–1.10, ♀ 1.05–1.25, preocular part ♂ 0.55–0.60, ♀ 0.55–0.70, postocular part ♂ 0.15, ♀ 0.10–0.15, length of eyes ♂ 0.35, ♀ 0.35–0.40; width across eyes ♂ 0.85, ♀ 0.80–0.85, interocular distance ♂ 0.35, ♀ 0.30–0.35, width in front of eyes ♂, ♀ 0.40–0.45, width of eyes ♂, ♀ 0.25, width behind eyes ♂, ♀ 0.60–0.65; length antennal segments I ♂ 1.10, ♀ 1.05–1.35, II ♂ 1.50, ♀ 1.35–1.50, III ♀ 1.60–1.85 (♂ missing), IV ♀ 1.55–1.60. Length rostral segments II ♂ 1.05, ♀ 1.10–1.20, III ♂, ♀ 0.95–1.05, IV ♂, ♀ 0.50. Median length of pronotum ♂ 1.50–1.70, ♀ 1.60–1.70, fore lobe ♂ 0.55, ♀ 0.55–0.65, hind lobe ♂ 0.65–0.85, ♀ 0.75–0.85, collar ♂ 0.25–0.30, ♀ 0.30; anterior width ♂ 0.70, ♀ 0.75–0.85, posterior width ♂ 1.55, ♀ 1.70–1.90. Scutellum length ♂ 0.55–0.70, ♀ 0.65–0.70, basal width ♂ 0.75, ♀ 0.80–0.85, commissure ♂ 0.95–1.00, ♀ 0.95–1.15. Length fore femora ♂ 2.50–2.55, ♀ 2.30–2.65, tibiae ♂ 2.25–2.55, ♀ 1.75–2.35, mid femora ♂ 2.30–2.45, ♀ 2.15–2.50, tibiae ♂ 2.05–2.30, ♀ 2.00–2.95, hind femora ♂ 3.00–3.30, ♀ 3.00–3.50, tibiae ♂ 3.50–3.75, ♀ 3.25–4.00. Length of body ♂ 7.75–8.10 mm, ♀ 8.00–8.75 mm; width across hemelytra ♂ 1.60 mm, ♀ 1.75–2.05 mm (type material).

Remarks

S. henriettae is found so far only in Queensland. It is very close in appearance and body measurements to *S. communis* and *S. imitator*; from the former it differs by the less shiny hind lobe of pronotum, from the latter by the absence of the pink tones of the veins of the corium. The difference between the male and female genitalia of *S. henriettae* and these two species is very obvious: the presence of the hook on the top of the blade of the paramere (lacking in *S. communis* and *S. imitator*) and the asymmetrical vagina and parietal glands (symmetrical in these two species).

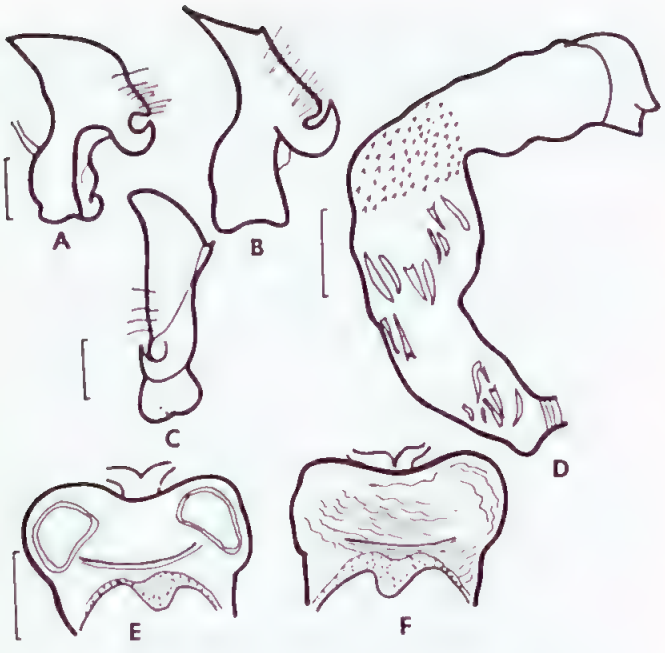

FIGURE 4. *Stenonabis henriettae* sp. nov.: a, b, c — paramere, various positions; d — aedeagus; e — vagina, view from above; f — the same, from below.

Stenonabis imitator Kerzhner
(Figs 5a, b, c, d, e)

Stenonabis imitator Kerzhner, 1969: 310-312, Fig. 17.

Description

Head, collar and pronotum slightly shiny, hemelytra and scutellum dull, sometimes whole body except clypeus dull.

Head: dirty yellow with darkish clypeus; sometimes areas in front of and behind eyes and longitudinal stripe between eyes brownish yellow with brown clypeus; head beneath yellow to brownish yellow, sometimes whitish. Eyes and ocelli reddish brown or brown; antennifers brown, antennae and rostrum yellow or dirty yellow, antennal segment II brown apically.

Thorax: pronotum yellow or dirty yellow with median longitudinal stripe becoming very narrow and sometimes indistinct on hind lobe; collar yellow with median and two additional lateral stripes, sometimes indistinct; fore lobe with pale brown or brown, sometimes very indistinct, pattern; hind lobe with additional stripes on each side of median one: broad curved lateral and two narrower, broken, indistinct stripes between lateral and median. Collar with shallow punctures, those on hind lobe of pronotum deeper and denser; fore lobe raised above collar, hind lobe raised above front lobes basally; anterior and posterior margins of pronotum nearly straight; lateral margins slightly concave; fore lobe separated from hind by shallow impression. Scutellum yellow to dirty yellow with dark brown diffused median longitudinal stripe. Coxae yellow to dirty yellow, trochanters yellow; femora yellow to dirty yellow, hind (sometimes also mid) femora brown apically; tibiae yellow to dirty yellow, brown apically. Hemelytra yellow to dirty yellow; veins of corium and claval suture yellow with brownish lateral margins; R+M vein of corium pink or pinkish distally; apex of corium brown; membrane opaque, yellow or brownish yellow, with straight brown veins. Ventrally thorax yellow or brownish yellow; sometimes meso- and metasternum brownish; pleura yellow with broad median stripe, sometimes meso- and metapleura brownish yellow or dark brown.

Abdomen: yellow or brownish yellow ventrally with brown narrow median longitudinal stripe and broader lateral stripes on each side of median; sometimes all stripes fused together, diffused or indistinct, in this case whole abdomen becoming brownish yellow; sometimes median stripe and two lateral very indistinct, in this case whole abdomen appears brownish; connexivum dirty yellow or brownish.

Male and female genitalia: in Kerzhner (1969).

Type material

Holotype — 1 ♂, Queensland, Cairns District, A.M. Lea (SAMA); Paratypes — 4 ♂, 2 ♀ same data as for holotype (SAMA, ZIN, examined except for material from ZIN).

Other material examined

North Queensland: 1 ♂, Mossman, 25 March 1967, M.S. Upton (ANIC); 1 ♂, 1 ♀, The Boulders, via Babinda, 15 Dec. 1966, B. Cantrell (EUQ); 1 ♂, Innisfail, at light, 16 May 1954, P. Kennedy (EUQ); Northern Territory: 1 ♂, 1 km SE of Batchelor, at light, 12 Apr. 1966, N. McFarland (SAMA).

Measurements

In Kerzhner (1969).

Remarks

S. imitator is very similar in appearance and body measurements to *S. communis* and *S. henriettae,* but differs very clearly in the male and female genitalia; it also differs from these species in the pink tones of R+M vein of the corium (*S. henriettae*), in the less shiny hind lobe of the pronotum (*S. communis*).

Stenonabis geniculatus (Erichson)
(Figs 6a, b)

Nabis geniculatus Erichson, 1842: 282.
Reduviolus (Stenonabis) geniculatus: Reuter, 1908: 108.
Stenonabis geniculatus: Kerzhner, 1969: 300.

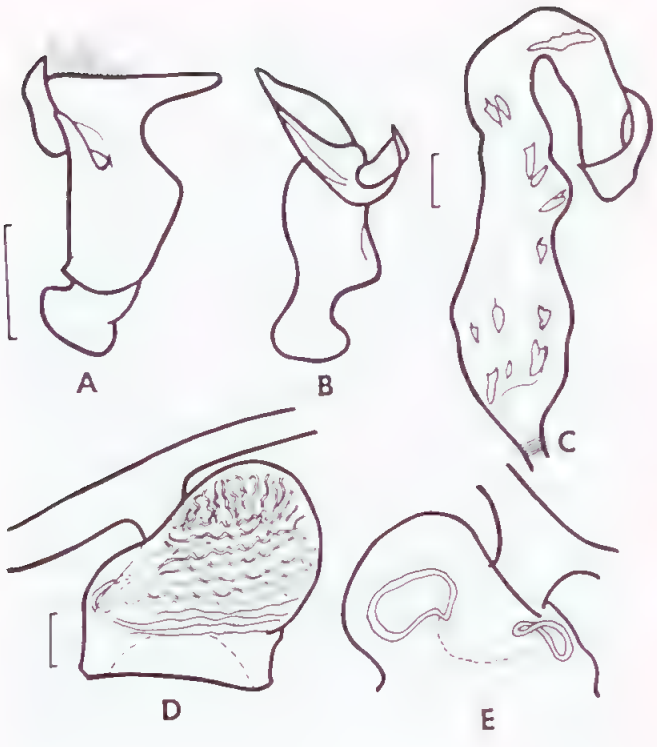

FIGURE 5. *Stenonabis imitator* Kerzh.: a — paramere, lateral view; b — the same, from below; c — aedeagus; d — vagina, view from above; e — the same, from below (Kerzhner 1969).

Description

Head, pronotum and abdomen shiny, hemelytra and scutellum dull.

Head: brown, whitish beneath; clypeus and juga smooth and more shiny than rest of head; head dorsally with two dark brown parallel lines between eyes, diverging toward clypeus; eyes and ocelli large, reddish brown. Antennal segments I and II yellow, II brown apically (segments III and IV missing). Rostral segment I yellowish brown, segment II brownish yellow, III and IV pale brown.

Thorax: pronotum yellowish brown with wide median longitudinal stripe; additional stripes on hind lobe of pronotum rudimentary, represented by two dark brown patches at base on each side of median stripe. Collar and hind lobe of pronotum with coarse punctures; demarcation between fore and hind lobe indistinct; anterior and posterior margins of pronotum slightly concave; lateral margins shallowly concave between lobes; fore lobe arched and raised above collar, hind lobe flat, short. Scutellum with wide black median stripe reaching apex and dirty yellow sides and with transverse impression basally. Coxae dark brown, hind ones yellow basally; trochanters brownish yellow; fore femora dark dorsally and yellowish brown ventrally, with elongated yellow, irregularly shaped patch on lateral surface distally and with yellow areas on ventral surface distally; mid femora yellowish brown, dark brown apically, with two small yellow patches on inner surface, third basal patch indistinct; hind femora brownish yellow with about distal 1/4 dark brown; fore tibiae dirty yellow, mid and hind tibiae yellow, dark brown apically. Fore femora stout, slightly swollen in basal half, mid femora with distal half thicker than basal one, hind femora thin. Coxae covered with short decumbent hairs, becoming longer and denser on femora, especially on ventral surface. Hemelytra very short, cover first visible tergite laterally, their apical margins straight, oblique, directed toward apex of scutellum, with a few very short hairs; membrane extremely short, hardly noticeable.

Abdomen: yellowish brown, with dark brown median longitudinal stripe dorsally; lateral margins and end of abdomen ventrally brownish yellow. Short decumbent yellow hairs ventrally, smooth and hairless dorsally, except for hairy lateral margins.

Male genitalia: unknown.

Female genitalia: vagina asymmetrical, very wrinkled above and beneath, with pointed rounded apex; parietal glands large, nearly symmetrical, visible from above (Fig. 6a, b).

Type material

Holotype — 1 ♀, brachypterous, Tasmania, Schayer (ZBM, examined).

Other material examined

Tasmania: 1 ♀, brachypterous, Cynthia Bay, Lake St Clair, 7–8 Feb. 1967, G. Monteith (QM). Males unknown.

Measurements

Head length 1.10–1.15, preocular part 0.55–0.60, postocular 0.10, length of eyes 0.45; width across eyes 1.00–1.05, interocular distance 0.45, width in front of eyes 0.50–0.55, width of eyes 0.25, width behind eyes 0.75. Length antennal segments I 0.70–0.75, II 1.00–1.15, III 1.20, (IV segment missing); length rostral segments II 1.00, III 1.00, IV 0.50. Median length of pronotum 1.55, fore lobe 0.75–0.80, collar 0.20–0.30; anterior width 0.95, posterior width 1.70–1.75; length of scutellum 0.55, width 0.60. Length fore femora 1.80–1.85, width 0.50, tibiae 1.75; mid femora 2.00, width 0.40–0.45, tibiae 1.70–1.75; hind femora 2.50, tibiae 2.75. Length of body 7.0–7.1 mm, width across abdomen 2.7–2.8 mm (holotype and another ♀ from Tasmania).

Remarks

S. geniculatus is a rare species; the specimen examined differs from the type by the general dark brown colour of the body and appendages (brownish yellow in the type), by the presence of two parallel dark brown lines between the eyes dorsally (lacking in the type) and by the evenly brown colour of the abdomen (yellow with a brown median longi-

tudinal stripe in the type); the size and proportions of the body in the two specimens are very close. The species differs from the other Australian species by the markings of the pronotum and the structure of the female genitalia.

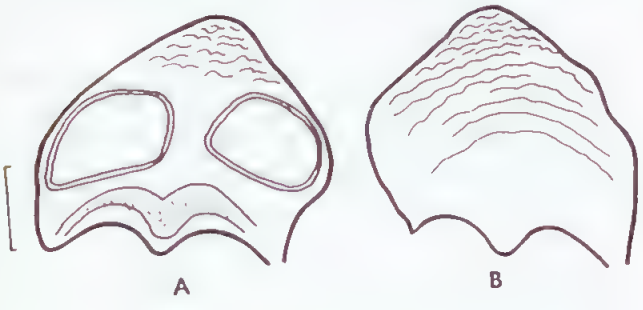

FIGURE 6. *Stenonabis geniculatus* Erich.: a — vagina, view from above; b — the same, from below.

Stenonabis roseus Kerzhner
(Figs 7a, b, c)

Stenonabis roseus Kerzhner, 1969: 306–307, Fig. 14.

Description

Light-coloured species: head and hind lobe of pronotum very shiny, collar and fore lobes less shiny, hemelytra and scutellum dull. Main colour pinkish yellow to dirty pink. Head, antennae, rostrum, legs and hemelytra pale, without any dark markings.

Head: Pinkish yellow with pinkish clypeus and brownish red eyes; antennifers darkish; antennal segment I pinkish yellow, other segments, as well as rostral ones, dirty yellow.

Thorax: Collar and fore lobe of pronotum pinkish yellow, hind lobe yellow; collar, pronotum and scutellum with light brown, rather narrow median stripe, sometimes widening at base of pronotum; fore lobe with light brown pattern; hind lobe with 2 or 3 additional broken pale brown stripes on each side of median one, sometimes without any visible additional stripes. Collar with dense punctures; pronotum with fore and hind lobes separated by shallow impression; anterior and posterior margins of pronotum slightly curved, lateral margins shallowly concave between lobes; hind lobe gradually raised toward hind margin; punctures on hind lobe coarser and deeper anteriorly, becoming finer and shallower posteriorly. Scutellum with yellow sides. Coxae and trochanters stramineous; fore femora pinkish yellow with about proximal 1/5 stramineous; mid and hind femora dirty yellow with about proximal 1/2 stramineous; all tibiae dirty yellow. Hemelytra pinkish yellow, well surpassing apex of abdomen, clavus and membrane basally dirty yellow, clavus with two rows of indistinct punctures alongside basal 1/2 of claval suture; all veins of corium or at least Cu vein pinkish or pink; membrane with brown veins. Ventrally thorax yellow with brown lateral stripe on each side.

Abdomen: shiny, brownish yellow beneath, except segments I–IV which are stramineous, with broken brown longitudinal stripes laterally, covered with extremely short decumbent hairs; connexivum brownish with yellow oval patch on each segment; genital segment pale brown.

Male genitalia: parameres large, with pointed apical process of blade and double hook ventro-laterally (Fig. 7a, b); aedeagus with few plane sclerites (Fig. 7c).

Female genitalia: in Kerzhner (1969).

Type material

Holotype — 1 ♀, Queensland, Cairns District, A.M. Lea (SAMA); Paratypes — 2 ♀, the same data (SAMA, ZIN; examined except for material from ZIN).

Other material examined

Queensland: 1 ♂ (head and pronotum missing), West Normandy R., 40 ml? of Cooktown, 5 May 1970, G. Monteith (QM); 1 ♀, Kuranda, 28 Dec. 1963, G. Monteith (QM).

Measurements

In Kerzhner (1969). Length of body 9.50–10.0 mm, width across hemelytra 2.10–2.15 mm (type material).

Remarks

S. roseus is known so far only from North Queensland and is distinguished from other species by its large and light pinkish body and appendages, by the markings of the pronotum and the structure of the male and female genitalia.

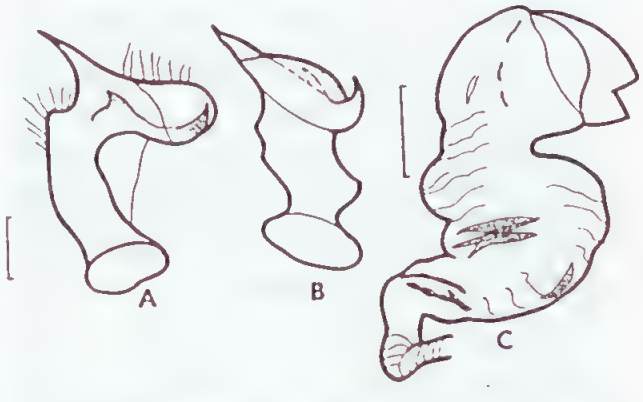

FIGURE 7. *Stenonabis roseus* Kerzh.: a, b — paramere, various positions; c — aedeagus.

Stenonabis nitidicollis Kerzhner
(Figs 8a, b, c, d)

Stenonabis nitidicollis Kerzhner, 1969: 307–308, Fig. 15.

Macropterous form

Head: brownish yellow, shiny, appearing whitish beneath; areas around eyes pale yellow; two dark brown parallel longitudinal lines restricting brownish areas between eyes; eyes and ocelli reddish brown. Antennae and rostrum yellow to dirty yellow, antennal segment II with dark brown ring at about distal 1/5. Short yellow hairs distally, white pubescence and longer sparse hairs ventrally; sides behind eyes nearly straight.

Thorax: pronotum shiny yellow with narrow brown median stripe, more or less widening at posterior margin of very shiny hind lobe; additional brown stripe on collar on each side; fore lobe with brown pattern; hind lobe with curved brown stripe on each side of median one, sometimes widening at posterior margin. Collar and hind lobe of pronotum with sparse, fine punctures; anterior and posterior margins of pronotum nearly straight, lateral impression between lobes shallow, demarcation between lobes indistinct medially; fore lobe slightly raised above collar, hind lobe raised toward posterior margin. Scutellum slightly shiny with wide black median stripe reaching apex. Legs brownish yellow to pale yellow, coxae pale yellow to dirty yellow with fore coxae brownish anteriorly; fore and mid femora brownish yellow, pale on inner surface and with short brown transverse stripes on outer surface; hind femora brownish yellow with brown ring near distal 1/5; all tibiae pale yellow with brownish ring apically. Hemelytra slightly shiny brownish yellow; commissure and veins of corium yellow with brownish rim along both sides, R+M and Cu veins of corium red for about posterior 1/2 and on border with membrane between veins thus forming triangular cell; space between veins yellow to dirty yellow; membrane hyaline, yellow, with brownish straight veins. Hemelytra reaching end of abdomen; covered with short yellow hairs basally and for 3/4 length laterally. Ventrally thorax yellow, metasternum with dark brown patch medially, pleura yellow with dark brown, nearly black longitudinal stripe on each side.

Abdomen: yellow beneath, with brown median longitudinal stripe and another one on each side of median; connexivum yellow with pinkish narrow external edge and small pinkish spots on each segment.

Brachypterous form

Head: dorsally dark brown, appearing whitish beneath; rostral segments I and II dirty yellow (segments III and IV and antennae missing).

Thorax: pronotum shiny, with coarse punctures on collar and hind lobe; anterior margin of pronotum slightly concave, posterior margin curved; demarcation between lobes indistinct; hind lobe not raised above fore lobe; pronotum shorter than in macropterous forms. Black median stripe on scutellum not reaching apex; scutellum with truncate apex, wider than long. Hemelytra dirty yellow, with indistinct veins, very short, covering first visible tergite laterally, apical margin straight, oblique, directed toward apex of scutellum, with few short hairs; membrane absent.

Abdomen: shiny, covered with short decumbent silvery hairs.

Male genitalia: paramere of medium size and distinct shape, with oblique tooth on top of blade and hook laterally (Fig. 8a, b, c); aedeagus small, with numbers of sclerites (Fig. 8d).

Female genitalia: in Kerzhner (1969).

Type material

Holotype — 1 ♀, New South Wales, Engadine (?) (difficult to read label), 6 Dec. 1958 (AMNH, not examined).

Other material examined

Queensland: 1 ♂, macropterous, Bald Mt. area, 3000′-4000′ via Emu Vale, 26-30 (month omitted) 1975, G. Monteith (QM); 1 ♂, macropterous, Crater Nat. Park, Atherton Tbld., 25 Apr. 1970 (QM); 1 ♀, macropterous, Brisbane, 5 Oct. 1962, E.A. Bernays (QM); 1 ♂, brachypterous, Upper Brookfield, 14 Apr. 1962, T.E. Woodward (QM).

Measurements

Macropterous form: head length ♂ 1.00, ♀ 1.05, preocular part ♂ 0.50, ♀ 0.55, postocular ♂ 0.10, ♀ 0.15, length of eyes ♂, ♀ 0.35; width across eyes ♂ 0.80-0.85, ♀ 0.85, interocular distance ♂ 0.35-0.40, ♀ 0.35, width in front of eyes ♂ 0.35-0.40, ♀ 0.45, behind eyes ♂ 0.55-0.60, ♀ 0.60. Length antennal segments I ♂ 0.85-0.95, ♀ 0.90, II ♂, ♀ 1.25, III ♂ 1.40, ♀ 1.50, IV ♂, ♀ 1.50. Length rostral segments II ♂ 0.95-1.00, ♀ 1.00, III ♂ 0.80-0.95, ♀ 0.95, IV ♂, ♀ 0.50. Median length of pronotum ♂ 1.40-1.50, ♀ 1.60, collar ♂, ♀ 0.25, fore lobe ♂ 1.0, ♀ 1,4 times shorter than hind lobe: ♂ 0.55-0.60, ♀ 0.55 and ♂ 0.60-0.65, ♀ 0.80 respectively; anterior width ♂ 0.65-0.70, ♀ 0.70, posterior width ♂ 1.60-1.70, ♀ 1.75. Scutellum length ♂ 0.60-0.65, ♀ 0.90, width ♂ 0.75, ♀ 1.00. Length fore femora ♂ 1.95-2.10, ♀ 2.00, tibiae ♂ 1.60-1.85, ♀ 1.80, mid femora ♂, ♀ 2.00, tibiae ♂ 1.60-1.85, ♀ 1.75, hind femora ♂ 2.50-2.75, ♀ 2.50, tibiae ♂ 2.75-3.25, ♀ 3.00. Total length of body: ♂ 6.0-7.5 mm, ♀ 7.6 mm; width across hemelytra ♂ 1.5-1.7, ♀ 1.7 mm (material examined).

Brachypterous form: head length (♂) 1.00, preocular part 0.51, postocular part 0.15, length of eyes 0.37, width behind eyes 0.15; antennae missing. Length rostral segment II 1.00 (III and IV missing). Median length of pronotum 1.25, collar 0.20; hind lobe very short, 1.3 times shorter than fore lobe

(0.45 and 0.60 respectively); anterior width of pronotum 0.75, posterior 1.50; scutellum length 0.60, width 0.75. Length fore femora 2.10, tibiae 1.85, mid femora 2.00, tibiae 1.75, hind femora 2.75, tibiae 3.25. Length of body (♂) 6.75, width across hemelytra 1.65 mm (examined material).

Remarks

S. nitidicollis differs from other species by its small size, by the kind of markings of the pronotum and by the structure of the male and female genitalia.

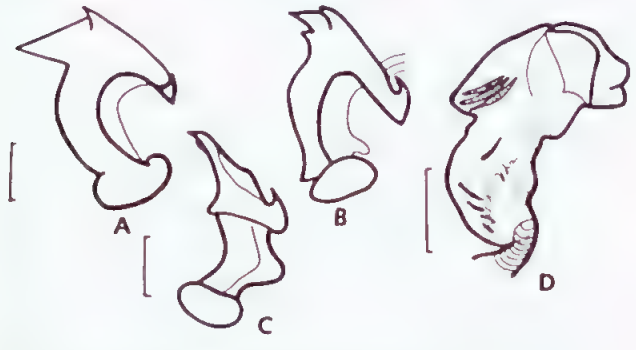

FIGURE 8. *Stenonabis nitidicollis* Kerzh.: a, b, c — paramere, various positions; d — aedeagus.

Stenonabis darwini Kerzhner
(Figs 9a, b, c)

Stenonabis darwini Kerzhner, 1969: 304–306, Fig. 13.

Description

Upper side of body slightly shiny, scutellum dull.

Head: brown; areas near eyes dirty yellow dorsally, with 2 dark brown lines, parallel between eyes and diverging before base of clypeus. Eyes and ocelli reddish brown; antennifers and antennal segments brownish yellow, segment II dark distally; rostral segments dirty yellow, segment IV dark distally.

Thorax: collar and pronotum dirty yellow, with dark brown markings: median longitudinal stripe, narrower on hind lobe distally and widening again basally, and 1 or 2 additional stripes on each side of median one so that all 5 stripes parallel and more prominent posteriorly; fore lobe with brown pattern. Collar and hind lobe of pronotum with fine punctures; anterior and posterior margins of pronotum straight, lateral margins shallowly concave between lobes. Scutellum dark brown, nearly black, with 2 small yellow patches laterally. Coxae and trochanters brownish yellow; fore femora yellow on inner and brownish on outer surface, mid femora brownish yellow on about proximal half and dark brown distally, hind femora with about proximal 2/3 yellow and about distal 1/3 brown; all tibiae yellow with dark brown apices. Hemelytra almost reaching apex of abdomen; clavus, corium and membrane yellow; corium with yellow, membrane with brown veins; membrane hyaline, with or without closed cells and with 9 or 10 veins at posterior margin. Ventrally thorax dark brown.

Abdomen: brownish yellow, with small yellow spot on each segment of connexivum, covered with short silver hairs, genital segment with long pale ones.

Male genitalia: parameres small, with tooth on top of blade medially and large hook laterally (Fig. 9a, b); aedeagus small, with 6 sclerites (2 dentate and 4 plane) in basal half (Fig. 9c).

Female genitalia: in Kerzhner (1969).

Type material

Holotype — 1 ♀, Darwin, G.F. Hill (SAMA) (examined).

Other material examined

Northern Territory: 1 ♂, 1 ♀, 5 km NW of Cahills Crossing, East Alligator River, 28 May 1973, M.S. Upton (ANIC); Queensland: 1 ♂, Lockerbie Area, Cape York, 13–27 Apr. 1973, G. Monteith (QM).

Measurements

Head length ♂ 1.05–1.35, ♀ 1.20–1.35, preocular part ♂ 0.55–0.75, ♀ 0.64–0.75, postocular part ♂ 0.15–0.20, ♀ 0.14–0.20, length of eyes ♂ 0.35–0.40, ♀ 0.40–0.43; width across eyes ♂ 0.80–0.95, ♀ 0.83–0.95, interocular distance ♂, ♀ 0.30–0.40, width in front of eyes ♂ 0.45–0.50, ♀ 0.44–0.50, behind eyes ♂ 0.60–0.65, ♀ 0.60–0.70. Length antennal segments I ♂ 1.30–1.50, ♀ 1.36–1.75, II ♂ 2.00–2.10, ♀ 2.10–2.35, III ♂ 2.45, ♀ 2.10–2.35, IV missing. Length rostral segments II ♂ 0.85–1.10, ♀ 0.86–1.10, III ♂ 0.95–1.00, ♀ 0.79–1.00, IV ♂ 0.50–0.55, ♀ 0.36–0.55. Median length of pronotum ♂ 1.45–1.70, ♀ 1.50–1.80, fore lobe ♂ 0.65, ♀ 0.60–0.70, collar ♂ 0.25–0.30, ♀ 0.30–0.35, anterior width ♂ 0.60–0.75, ♀ 0.70–0.80, posterior width ♂ 1.45–1.65, ♀ 1.50–1.75. Median length of scutellum ♂ 0.75, ♀ 0.70–0.75, basal width ♂ 0.70–0.80, ♀ 0.70–0.75. Length fore femora ♂ 2.45–2.50, ♀ 2.65–3.30, tibiae ♂ 2.25–2.50, ♀ 2.35–2.75, mid femora ♂ 2.25–2.75, ♀ 2.35–2.75, tibiae ♂ 2.25–2.50, ♀ 2.25–2.65, hind femora ♂ 3.40–4.00, ♀ 3.65–4.50, tibiae ♂ 3.70–4.25, ♀ 3.60–4.65. Length of body ♂ 7.75–9.00 mm, ♀ 8.80–9.60 mm, width across hemelytra ♂ 1.30–1.75 mm, ♀ 1.50–1.80 mm (material examined).

Remarks

S. darwini is known so far from the Northern Territory and Queensland and is distinguished from other Australian species by the narrow body, dark

coloration, proportions and markings of the pronotum and the structure of the male and female genitalia.

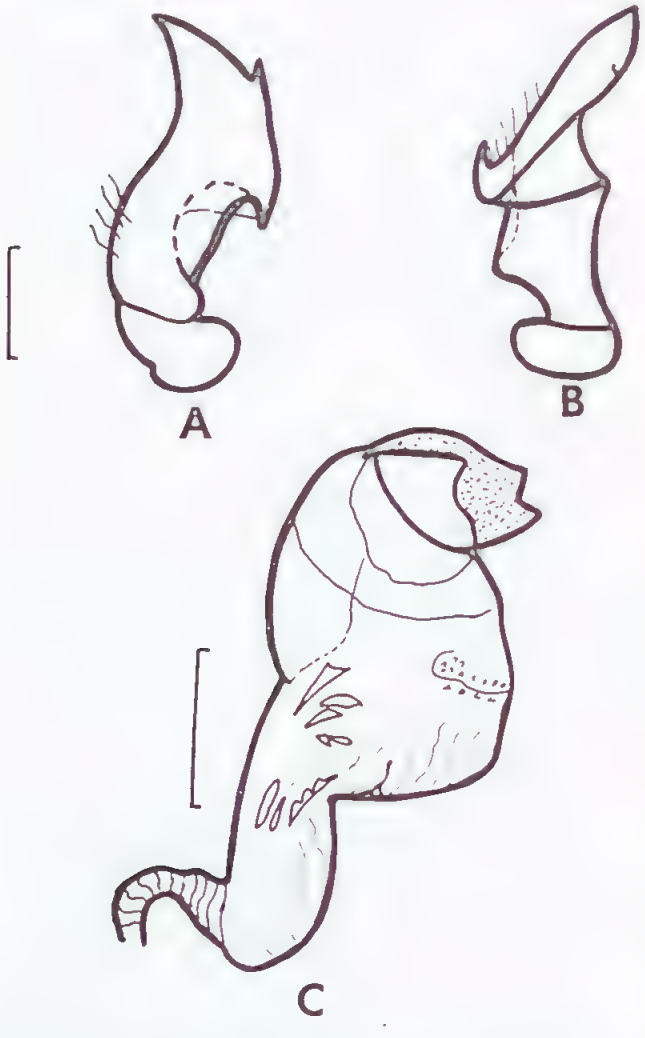

FIGURE 9. *Stenonabis darwini* Kerzh.: a — paramere, lateral view; b — the same, from below; c — aedeagus.

Stenonabis morningtoni sp. nov.
(Figs 10a, b, c, d)

Description

Head dorsally, pronotum and abdomen shiny, scutellum, hemelytra and thorax dull.

Head: dark brown dorsally except for dirty yellow areas around eyes; appears whitish beneath. Antennal segments I and II brown (III and IV missing); rostral segments yellow except for brown I one; antennal segment II with brownish distal fifth. Short silver hairs ventrally and on areas around eyes dorsally and a few long fine hairs on each side laterally. Ocelli large, shiny, nearly touching posterior margin of head, with anterior margins in front of level of posterior margins of eyes.

Thorax: pronotum yellow with wide brown median longitudinal stripe; collar brownish ventrally, with narrow brown additional stripe on each side of median one laterally; fore lobe with brown pattern; hind lobe with 2 parallel brownish stripes laterally on each side of median one, one of them, nearest to median, broken and indistinct. Collar with very fine and hind lobe of pronotum with coarse punctures; fore lobe raised above collar rather steeply, hind lobe raised above fore lobe gradually toward base of pronotum; demarcation between lobes indistinct; anterior margin of fore lobe slightly convex, posterior margin of hind lobe nearly straight; lateral margins of pronotum shallowly concave, nearly straight between fore and hind lobes; fore lobe 1.15 times longer than hind lobe. Scutellum yellow with broad black median longitudinal stripe reaching its apex and with basal impression and pointed apex. Thorax beneath yellowish brown with yellow metasternum and dark brown meso- and metapleura. Legs brownish yellow, coxae and trochanters yellow, fore coxae brown anteriorly; fore femora dirty yellow on inner lateral surface and much darker outside dorsally and ventrally; mid and hind femora dirty yellow, pale yellow basally, brown apically, with indistinct pale brown ring medially; all tibiae brownish yellow. Hemelytra brownish yellow with indistinct veins, corium covered with two rows of punctures alongside basal 1/2 of claval suture; membrane greyish yellow, translucent, with 3 closed cells; hemelytra surpassing apex of abdomen.

Abdomen: brown beneath, with yellowish brown basal area and dirty yellow connexivum; abdomen covered with short dense silver hairs; small shiny areas free of hairs on II basal segment of connexivum.

Male genitalia: parameres large, with wide blade and 3 hooks on it, big hook ventro-laterally with pointed apex and 2 smaller ones dorsally, one of these at base of blade and another on top of blade medially (Fig. 10a, b, c); aedeagus of medium size, with 6 rather big sclerites (3 plane and 3 with forked end, Fig. 10d).

Type material

Holotype — 1 ♂, macropterous, Qld. Mornington Cr. (? not clear writing), J. Mission, 15 May 1963, N.B. Tindale and P. Aitken (SAMA). Females unknown.

Measurements

Head length 1.15, preocular part 0.60, postocular part 0.15, length of eyes 0.40; width across eyes 0.85, interocular distance 0.30, width in front of eyes 0.45, behind eyes 0.55. Length antennal segments I 0.85, II 1.25; length rostral segments II 0.80, III 0.95, IV 0.30. Median length of pronotum 1.70, collar 0.30, fore lobe 0.75, hind lobe 0.65; anterior width 0.85, posterior width 1.80. Scutellum length 0.85, width 1.00. Length fore femora 2.00, tibiae 1.55, mid

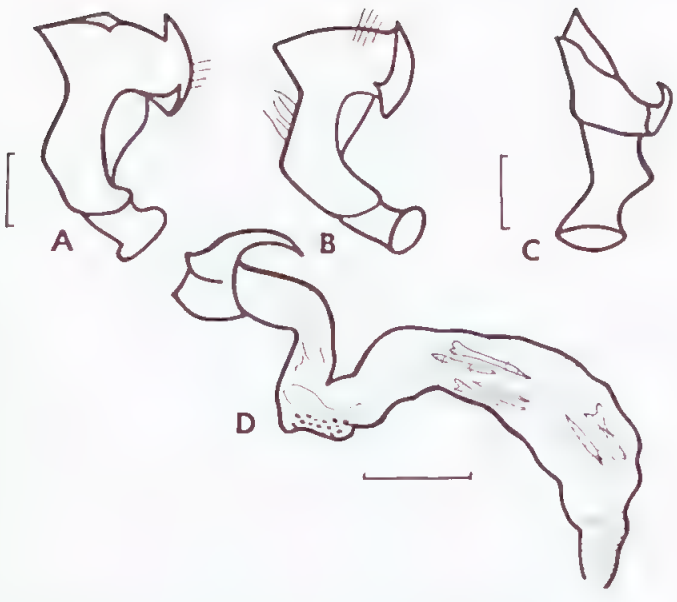

FIGURE 10. *Stenonabis morningtoni* sp. nov.: a, b, c — paramere, various positions; d — aedeagus.

femora 1.90, tibiae 1.75, hind femora 2.60, tibiae 2.80. Length of body 8.0 mm, width across hemelytra 2.2 mm (holotype).

Remarks

The species is known only from type locality in Queensland. It is close in appearance to other *Stenonabis* species, but is clearly distinguished by the kind of markings of the pronotum and by the distinct shape of the male genitalia.

Acknowledgments

This study was supported and the facilities provided by the Museum of Victoria, for which special thanks are due to Dr A. Neboiss and Mr K. Walker. For the loan of the material, the author is grateful to the Museums listed in the Introduction. Particularly appreciated was the help of the late Dr T.E. Woodward and Dr I.M. Kerzhner, of the Zoological Institute, Academy of Science, USSR, in the preparation of this paper. (Dr Kerzhner helped especially with the drawings of the female genitalia in *Nabis fraternus* and *Nabis biformis*, as well as the 'Remarks' to *Nabis kinbergii*).

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APPENDICULAR OSTEOLOGICAL DIFFERENCES BETWEEN *LASIORHINUS LATIFRONS* (OWEN, 1845) AND *VOMBATUS URSINUS* (SHAW, 1800) (MARSUPIALIA: VOMBATIDAE)

G.G. SCOTT & K.C. RICHARDSON

SCOTT, G.G. & RICHARDSON, K.C. 1988. Appendicular osteological differences between *Lasiorhinus latifrons* (Owen, 1845) and *Vombatus ursinus* (Shaw, 1800) (Marsupialia: Vombatidae). *Rec. S. Aust. Mus.* 22(2): 95-102.

Brachial, antebrachial and carpal bones from the hairy-nosed wombat *(Lasiorhinus latifrons)* and common wombat *(Vombatus ursinus)* are, with the exception of the first and second carpal bones, all distinguishable. Likewise the pelvis, femur, tibia, fibula and epipubic bones from the hairy-nosed wombat *(L. latifrons)* and common wombat *(V. ursinus)* all have specific characteristic differences. To facilitate rapid specimen identification at the generic level, the different gross morphological features are summarised.

A number of consistently different features between specimens of the two genera have been recognised during this study. In the forelimb the scapula has a large process present on its caudal angle in *L. latifrons,* but only a tubercle is present in *V. ursinus.* The scapula spine is narrow in *L. latifrons,* and broad in *V. ursinus.* The coracoid process groove which accommodates the bicipital tendon is wide in *L. latifrons,* but narrow in *V. ursinus.* The scapula articular tuberosity is vestigial in *L. latifrons,* but well developed in *V. ursinus.* A deep triangular fossa is adjacent to the scapula infra-articular tuberosity in *L. latifrons,* but absent in *V. ursinus.* The clavicular shaft has a convex medial surface in *L. latifrons,* but this is sharp and sickle-shaped in *V. ursinus.* A large ridge on the laterodorsal surface of the shaft in *L. latifrons* is vestigial in *V. ursinus.* The sternoclavicular surface is roughened with a deep fossa in *L. latifrons,* but roughened having a fossa confluent with a deep groove in *V. ursinus.* The acromioclavicular articular surface has a large tubercle in *L. latifrons,* which is vestigial in *V. ursinus.* The clavicular breadth, diameter of the humeral head, and the width of the humeral shaft are all significantly different.

Many previously unrecorded, consistent differences were found in the hindlimb. The pelvic iliac crest is directed laterally and forms a right angle with body of ilium in *L. latifrons,* but is 'sickle-shaped' in *V. ursinus.* Its lateral extremity is expanded in *L. latifrons,* but pointed in *V. ursinus.* The iliopectineal eminence is a large process in *L. latifrons,* but a small tubercle in *V. ursinus.* The pelvic ischiatic tuberosity is narrow, approximately 20 mm, in *L. latifrons,* but wide, approximately 40 mm, in *V. ursinus.* Epipubic bones are quite distinct, with the articular surface broad and elongate in *L. latifrons,* but narrow in *V. ursinus.* Its proximal ventral surface is deeply concave in *L. latifrons,* but flat in *V. ursinus.* The femur has few distinguishing features; the greater trochanter is deeply grooved in *L. latifrons,* but is only a tuberosity in *V. ursinus.* On the tibia the medial intercondylar eminence is long craniocaudally in *L. latifrons,* but pointed in *V. ursinus.* The articular surface for the lateral condyle of the femur is circular in *L. latifrons,* but elongate in *V. ursinus.* Other than a number of trivial differences in the fibula the only reliable, readily recognisable difference is that the medial and caudal borders of its plantar surface are rounded in *L. latifrons,* but square in *V. ursinus.* The pelvic length and breadth, femur length and fibular length are all significantly different.

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Individual bones, particularly small ones such as the carpals, tarsals and phalanges, are commonly found once decomposition, disarticulation and weathering all play their part on the body of a dead animal. These bones, commonly scattered over the terrain, may be found individually, sometimes a few together, and occasionally large numbers in a protected site or archaeological digging. Whatever the case, the identification of these bones is often difficult. In some instances species identification may be biased by modern perceptions of zoogeographic boundaries.

This study collates the scanty information previously published on osteology of the wombat forelimb (Owen 1838, Murie 1867, De Vis 1892, Scott 1915) as well as that of the hindlimb (Owen 1838, Murie 1867, De Vis 1892). It describes the diagnostic features of bones of the forelimb and hindlimb of the hairy-nosed wombat *(Lasiorhinus latifrons)* and of the common wombat *(Vombatus ursinus)* which separate the extant genera.

Materials and Methods

Specimens

Bones of the forelimb and hindlimb of *L. latifrons* and *V. ursinus* were examined in the collections of the Australian Museum, Sydney; British Museum (Natural History), London; Museum of Victoria, Melbourne; Queensland Museum, Brisbane; South Australian Museum, Adelaide; and

Western Australian Museum, Perth. For this study additional specimens of *L. latifrons* were collected at Blanchetown, Roonka and Swan Reach in South Australia; and of *V. ursinus* over the Great Dividing Range and adjacent regions.

Measurements

The morphology of individual bones of the forelimb was examined and any distinguishing features noted. Adult and juvenile specimens were examined, but only bones from adults were compared for diagnostic purposes. Linear measurements were made with vernier calipers on adult specimens.

Forelimb Measurements

1. Scapula
   (i) breadth, measured from the cranial angle to the caudal angle.
   (ii) length, measured from the supraglenoid tubercle to the cranial angle.
2. Clavicle
   (i) length, measured from the clavicle-acromion articular surface to the clavicle-sternum articular surface.
   (ii) breadth, measured at the point of maximum constriction of the shaft proximal to the clavicle-sternum articular surface.
3. Humerus
   (i) length, measured from the proximal surface of the head to the distal surface of the capitulum.
   (ii) head diameter, measured lateromedially.
   (iii) deltoid tuberosity, maximum height above the shaft.
   (iv) articulating condyles, width measured from the lateral surface of the lateral epicondyle to the medial surface of the medial epicondyle.
   (v) shaft width, minimum measurement proximal to the deltoid tuberosity, but distal to the greater tubercle.
4. Ulna
   (i) length, measured from the proximal olecranon to the distal surface of the styloid process.
5. Radius
   (i) length, measured from the proximal surface of the head to the distal surface of the styloid process.

Hindlimb Measurements

1. Pelvis
   (i) length, from the proximal surface of the iliac crest to the distal surface of the ischial tuberosity.
   (ii) breadth, from the medial surface of the iliac tuberosity to the lateral surface of the iliac process.
2. Femur
   (i) length, from the proximal surface of the head to the distal surface of the medial condyle.
   (ii) shaft diameter, midway along the shaft.
3. Tibia
   (i) length, from the proximal surface of the intercondylar eminence to the distal surface of the medial malleolus.
   (ii) shaft diameter, midway along the shaft.
4. Fibula
   (i) length, from the proximal surface of the lateral condyle to the distal surface of the lateral malleolus.
   (ii) shaft diameter, midway along the shaft.

The bones of the distal forelimb and hindlimb were examined only for morphological differences. Osteological terminology used is as in the 'Nomina Anatomica Veterinaria' (Habel *et al.* 1983).

Analysis

Where appropriate Student's t-test, 2-'sided', and bivariate analysis (Simpson *et al.* 1960) was used. Bivariate regression analysis of specimens of known sex shows no significant sexual dimorphism for any of the characters examined, so measurements of both sexes were combined.

RESULTS

Measurements

For most features measured there was an overlap in the range of measurements between *V. ursinus* and *L. latifrons*. However, clavicle breadth, humerus shaft width, the lateromedial diameter of the humeral head, pelvis breadth and femur length were all significantly larger ($P < 0.001$) in *V. ursinus*. Pelvis length ($P < 0.01$) and fibula length ($P < 0.05$) were also larger in *V. ursinus*. Forelimb measurements for both genera are given in Table 1. Hindlimb measurements for both genera are given in Table 2.

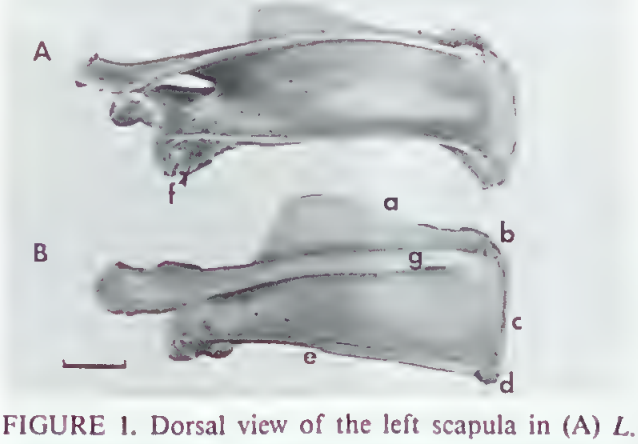

FIGURE 1. Dorsal view of the left scapula in (A) *L. latifrons* and (B) *V. ursinus*. Where a, cranial border; b, cranial angle; c, vertebral border; d, caudal angle; e, caudal border; f, arrowed, infra-articular tuberosity; g, spine. Scale line is 2 cm.

Morphology

The following morphological features were found to be diagnostically different for the two genera:

Scapula

	L. latifrons	*V. ursinus*
Caudal angle	large process	small tubercle
Dorsal spine	about 3 mm wide	about 6 mm wide
Coracoid process	deep and widely grooved, no fossa	narrow groove, large fossa present
Infra-articular tuberosity	(i) vestigial	well-developed
	(ii) deep triangular fossa present	no fossa, only roughened surface

Clavicle

	L. latifrons	*V. ursinus*
Shaft		
(i) Medial surface	convex	sharp and sickle-shaped
(ii) Latero-dorsal surface	large ridge	vestigial
Sternal articular surface	deep fossa present	fossa confluent with a deep groove
Scapula articular surface	large tubercle present	vestigial

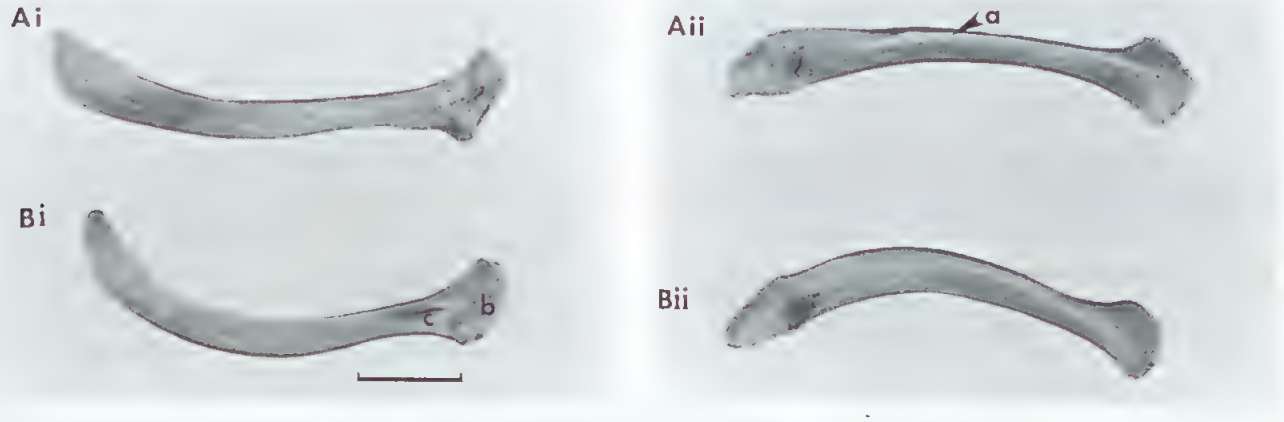

FIGURE 2. Right clavicle in (A) *L. latifrons* and (B) *V. ursinus*. (i) is a dorsolateral view, (ii) is a medial view. a, arrowed, large ridge; b, fossa; c, groove. Scale line is 2 cm.

TABLE 1. Forelimb measurements (mm) for *L. latifrons* and *V. ursinus*.

	L. latifrons			*V. ursinus*		
	n	mean	sd	n	mean	sd
Scapula breadth	6	49.0	7.58	21	53.6	3.13
Scapula length	6	119.6	7.41	19	122.5	4.09
Clavicle length	4	81.5	3.03	14	83.9	4.74
Clavicle breadth	5	6.3	0.70	14	7.3	0.59***
Humerus length	7	108.1	7.89	29	121.7	3.82
Humerus diameter	7	26.9	2.23	28	29.8	1.35**
Humerus deltoid tuberosity height	13	27.2	2.00	29	27.2	1.43
Humerus articular condyle width	9	50.6	3.55	25	54.5	1.97
Humerus shaft width	19	13.1	1.19	29	14.6	0.85***
Ulna length	4	141.9	10.90	13	154.2	6.95*
Radius length	4	109.8	6.41	10	115.7	4.97

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

TABLE 2. Hindlimb measurements (mm) for *L. latifrons* and *V. ursinus*.

	L. latifrons			*V. ursinus*		
	n	mean	sd	n	mean	sd
Pelvis length	3	184.5	20.54	17	206.9	8.16**
Pelvis breadth	5	56.7	3.65	14	71.6	4.28***
Femur length	3	141.2	1.33	25	156.3	5.76***
Femur shaft diameter	3	14.5	0.63	27	15.1	0.81
Tibia length	3	116.1	7.13	14	122.8	5.20
Tibia shaft diameter	5	8.5	0.65	15	9.0	0.76
Fibula length	4	110.7	0.38	10	116.8	4.73*
Fibula breadth	6	7.0	0.44	9	6.9	0.60

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

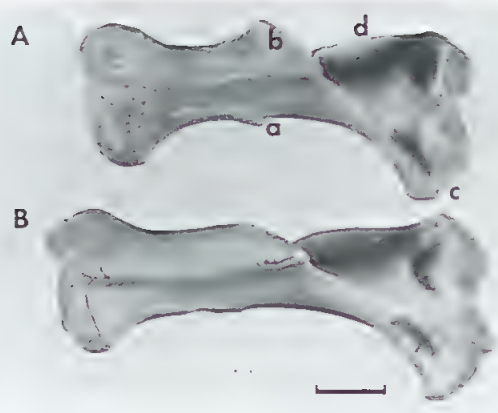

FIGURE 3. Cranial view of the left humerus in (A) *L. latifrons* and (B) *V. ursinus*. Where a, teres tuberosity; b, deltoid tuberosity; c, medial epicondyle; d, lateral epicondyloid crest. Scale line is 2 cm.

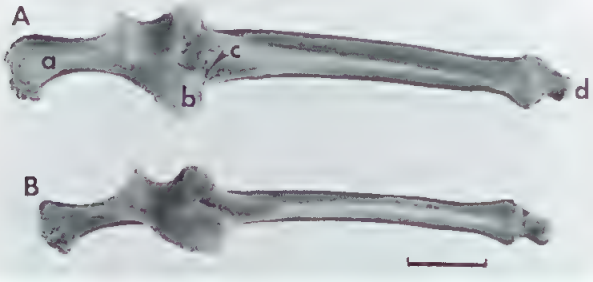

FIGURE 4. Lateral view of the left ulna in (A) *V. ursinus* and (B) *L. latifrons*. Where a, olecranon; b, arrowed, coronoid process; c, arrowed, pit for the radial tuberosity; d, styloid process. Scale line is 2 cm.

Humerus

	L. latifrons	*V. ursinus*
Deltoid tuberosity	acutely angled ridge	shallow angled ridge
Teres tuberosity	small	elongate
Lateral epicondyloid crest	straight caudal border	shallowly convex proximally, concave distally

Ulna

	L. latifrons	*V. ursinus*
Anconeal process		
(i) cranioproximal surface	ridge	large process
(ii) viewed laterally	cranial surface parallel to caudal surface	sickle-shaped
Coronoid process	elongated	circular
Shaft		
(i) Depression for radial tuberosity	shallow	larger circular pit
(ii) Lateral surface	flat proximally, and concave distally	concave

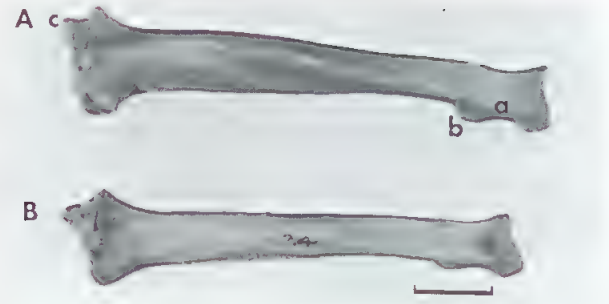

FIGURE 5. Craniomedial view of the left radius in (A) *V. ursinus* and (B) *L. latifrons*. Where a, neck; b, radial tuberosity; c, arrowed, styloid process. Scale line is 2 cm.

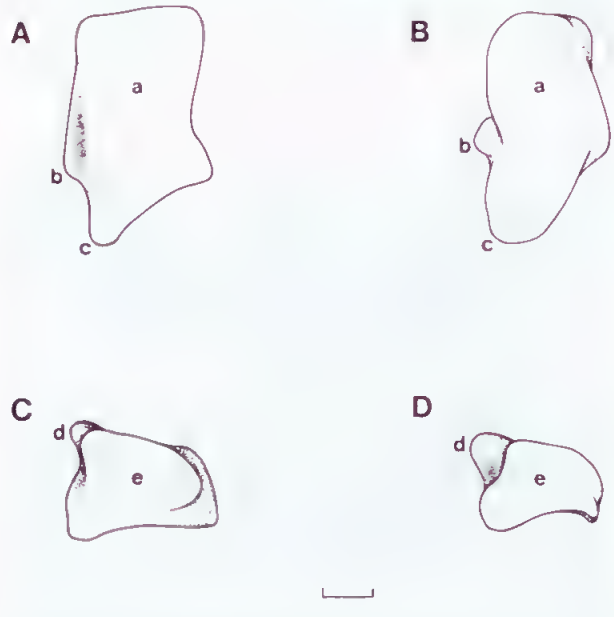

FIGURE 6. Proximal view of left radial carpal bone in (A) *L. latifrons* and (B) *V. ursinus*. Where a, radial surface; b, palmar tuberosity; c, medial tubercle. Proximal view of right ulnar carpal bone in (C) *L. latifrons* and (D) *V. ursinus*. Where d, palmar tuberosity; e, ulnar surface. Scale line is 5 mm.

Radius

	L. latifrons	*V. ursinus*
Neck	shallow concavity proximal to radial tuberosity	deeply concave
Shaft		
Lateral surface	flat	deep oblique depression

Distal forelimb
Radial carpal bone:

	L. latifrons	*V. ursinus*
Palmar tuberosity	small	large
Medial tubercle	small and tapered	massive and blunt

Ulnar carpal bone:

	L. latifrons	*V. ursinus*
Ulnar articular facet	small and oval	large, concave and semi-circular
Accessory carpal articular facet	small	circular with pronounced lateral tubercle
Palmar facet elongate for 3rd and 4th carpal bones		circular

Accessory carpal bone:

	L. latifrons	*V. ursinus*
Ulnar carpal articular facet	lateral border short and square	lateral border elongate
Medial proximal tubercle	small	pronounced
Shaft	broad and flat	constricted in middle

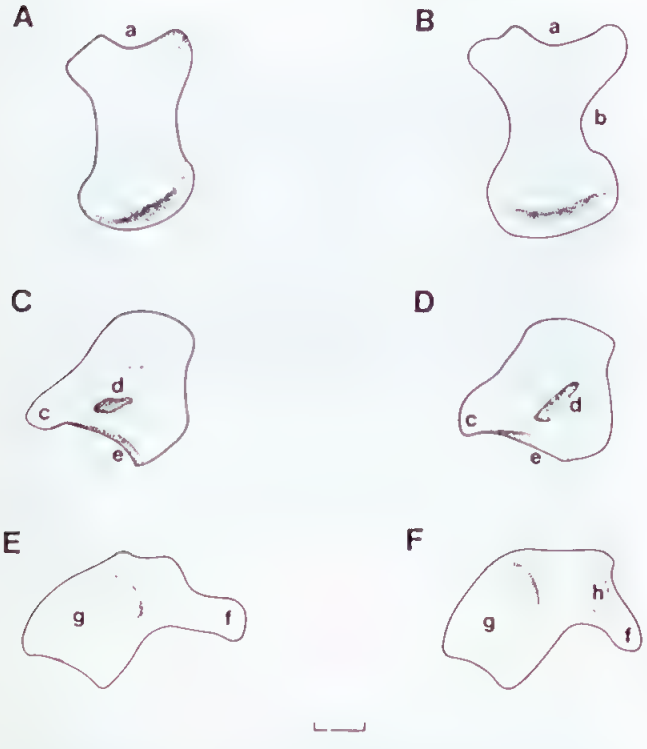

FIGURE 7. Proximal view of the right accessory carpal bone in (A) *L. latifrons* and (B) *V. ursinus*. Where a, proximal facet for the ulnar carpal bone; b, constricted shaft. Medioproximal view of the right 3rd carpal bone in (C) *L. latifrons* and (D) *V. ursinus*. Where c, medial process; d, sulcus; e, articular surface for 3rd metacarpal. Proximal view of the right 4th carpal bone in (E) *L. latifrons* and (F) *V. ursinus*. Where f, hamulus; g, articular facet for ulnar carpal bone; h, fossa. Scale line is 4 mm.

Third carpal bone:

	L. latifrons	*V. ursinus*
Mediodistal process	large and pointed	broad and squat
Proximal sulcus	shallow	deep

Fourth carpal bone:

	L. latifrons	*V. ursinus*
Palmar articular facet for 4th and 5th metacarpals	small and shallow	large and deep
Hamulus	narrow	broad at its base
Body of ulnar carpal separated from hamulus by —	shallow fossa	deep fossa

No consistent gross morphological differences were found for the first carpal bone, second carpal bone, metacarpals or phalanges.

Pelvis

	L. latifrons	*V. ursinus*
Iliac crest	(i) points laterally and forms sharp angle with body of ilium	points caudally 'sickle-shaped'
	(ii) lateral extremity broad	pointed
Iliac fossa	present	absent
Iliopectineal eminence	large	small
Ramus of pubic bone	same width as pubic bone between the obturator foramina	half width of pubic bone between the obturator foramina
Rectus femoris m. origin	deep fossa on body of ilium	indistinct
Surface area of Ischiatic table	approximately same as obturator foramen	much smaller
Ischiatic tuberosity	narrow, approximately 20 mm wide at point of maximum width	well-developed, approximately 40 mm wide

FIGURE 8. Ventral view of the pelvis in (A) *L. latifrons* and (B) *V. ursinus*. Where a, iliac crest; b, arrowed, iliopectineal eminence; c, arrowed, pecten; d, obturator foramen; e, acetabulum; f, ischiatic table; g, ischiatic tuberosity. Scale line is 2 cm.

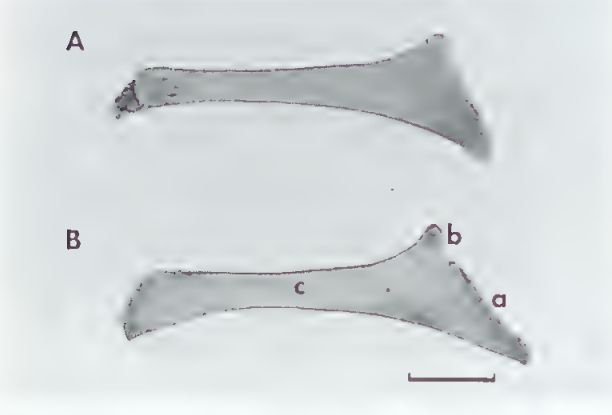

FIGURE 9. Dorsal view of right epipubic bone in (A) *L. latifrons* and (B) *V. ursinus*. Where a, articular surface for pecten of pubis; b, arrowed, proximal tubercle; c, shaft. Scale line is 2 cm.

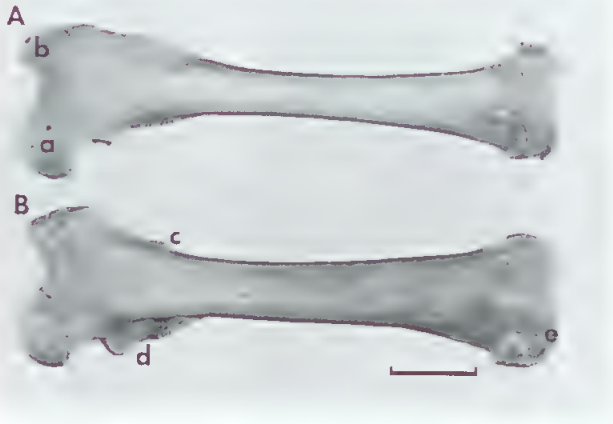

FIGURE 10. Cranial view of left femur in (A) *L. latifrons* and (B) *V. ursinus*. Where a, head; b, greater trochanter; c, 3rd trochanter; d, lesser trochanter; e, medial condyle. Scale line is 2 cm.

Epipubic bone

	L. latifrons	*V. ursinus*
Articular surface for pectin of pubic bone	elongate with medial surface much broader than lateral surface	narrow elongate with parallel sides
Proximal ventral surface	concave	flat
Lateral tubercle	indistinct	pronounced

Femur

	L. latifrons	*V. ursinus*
Greater trochanter	deeply grooved	indistinct groove
Lesser trochanter	present	pronounced
Third trochanter	pronounced	present

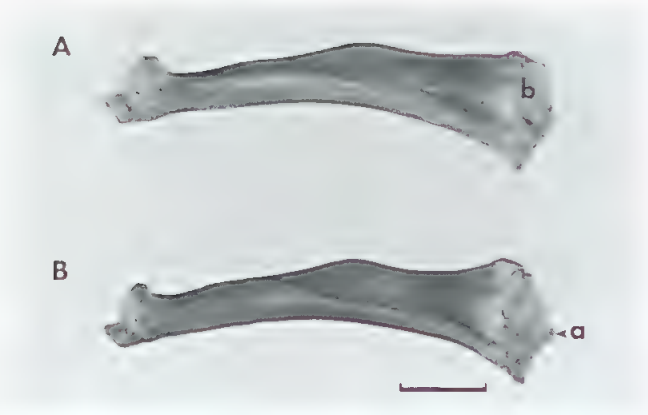

FIGURE 11. Lateral view of left tibia in (A) *L. latifrons* and (B) *V. ursinus*. Where a, arrowed, medial intercondylar eminence; b, arrowed, articular surface for fibula. Scale line is 2 cm.

Tibia

	L. latifrons	*V. ursinus*
Medial intercondylar eminence	same size as lateral	larger than lateral
Lateral condyle		
(i) lateral surface	almost flat	angled
(ii) articular surface for lateral condyle of femur	circular	elongate

Fibula

	L. latifrons	*V. ursinus*
Malleolus (plantar view)	rounded, medial surfaces	square

Distal hindlimb

Tarsal bone morphology varied considerably within each genus. No diagnostic differences were found between the two wombat genera for the tibiotarsal, fibular tarsal, central tarsal bones, or for 1st, 2nd, 3rd and 4th tarsal bones. No morphological differences were observed for the metatarsals and phalanges.

Discussion

This study found that a number of the morphological features claimed by Murie (1867) as being diagnostically significant for separating the forelimb bones of *L. latifrons* from those of *V. ursinus* are not reliable. For instance Murie's claim that a marked difference exists between the proportion of length to breadth of the scapula of the two wombat taxa (56% in *L. latifrons* and 72% in *V. ursinus*) was found to be marginal. Other differences such as scapula shape and curvature of the scapular spine, as well as the variations in depth of the sulcus for the bicipital tendon as described by Murie (1867) were found to be inconsistent and of no diagnostic value.

Likewise Murie (1867) claimed that the anterior border of the ilium points downwards in *L. latifrons*, but outwards in *V. ursinus*, and that the femoral shaft breadth is greatest in *L. latifrons*. He also reported that the fibula length was equal in both wombat genera, and that the fibula shaft was straighter in *L. latifrons*. None of these findings are supported in this study.

The current study tabulates a number of diagnostic morphological differences allowing many individual wombat bones of the appendicular skeleton to be identified to generic level. In addition to this it was noted that the scapula of *V. ursinus* bears a larger surface area for the insertion of M. trapezius and M. deltoidius than does the scapula of *L. latifrons*. However, the *L. latifrons* scapula possesses a larger and more developed surface for the insertion of M. rhomboideus and M. serratus ventralis. The significance of this difference in muscle insertion sites is reflected not only in differences in the overall structural mechanics of the thoracic limb of the two wombat taxa, but also in differences in their burrowing and locomotor behaviour.

For example, *V. ursinus* more readily accommodates the actions of the trapezius muscle to elevate and protract the limb and the deltoideus muscle to flex the shoulder joint as well as to lift the humerus. By contrast *L. latifrons* is more adapted to accommodate the action of rhomboideus muscle which elevates and retracts the limb and shoulder. The ventral serrate muscle supports the trunk, and carries the trunk forward or backward. These features are probably linked to *L. latifrons* being a plains dweller which digs burrows into a flat, usually limestone-underlaid, topography; while *V. ursinus* is an inhabitant of the mountainous eucalyptus forests, and commonly resorts to digging its burrows into decomposed granite.

The bones of the forearm in both genera are well adapted for pronation and supination, both important prerequisites for their burrowing. It is also evident, that except for relative size, the general overall morphological structure of the forelimb skeleton in the wombat is quite similar to those of the kangaroo and the koala.

Ultimately, differences in forelimb osteology of *L. latifrons* and *V. ursinus* can be explained by reference to differences in their myology and structural mechanics. Sonntag (1923), and more recently Hildebrand (1974) have set the lead in this respect. However, Sonntag only looked at the myology of *V. ursinus*, while Hildebrand only considered the structural mechanics of the forelimb of *L. latifrons*. In both cases their work was generalised

and did not attempt to explain the functional anatomy of the two wombat genera.

Of all the hindlimb bones studied, the pelvis shows more pertinent morphological differences between the two extant wombat species. However, relating these differences to the functional anatomy of the pelvis, and the hindlimb in general, awaits comprehensive information on the musculature of the hindlimb in the two wombat species. No detailed work has been done on wombat hindlimb myology. Waterhouse (1846), Macalister (1850), Sonntag (1923), and Elftman (1929) provided only general information on wombat *(V. ursinus)* musculature. Their studies described the origins and insertions of a small number of muscle groups, but lacked detail, definitions and figures. In most instances they are of little value for interpreting the functional musculoskeletal anatomy of the pelvic region of the two wombats.

Although this paper has compared the osteological differences of the hindlimb of *L. latifrons* and *V. ursinus,* the interpretation of these differences in terms of their respective functional anatomy awaits a detailed investigation of the myology of the pelvic limb.

Acknowledgments

We would like to thank Dr C.P. Groves, Australian National University; Dr T. Flannery, Australian Museum; Dr D. Horton, Institute of Aboriginal Studies; Joan Dixon, National Museum of Victoria; Dr R. Molnar, Queensland Museum; Dr C. Kemper, South Australian Museum, for making material available to us; and Dr D. Kitchener, Western Australian Museum for the specimens used in the photographs. Drs C.P. Groves and D. Horton both gave valuable advice and support over the duration of the project. We wish to thank Mr G. Griffiths for photography and Ms D. Passmore for so carefully typing the paper and earlier drafts. The project was primarily supported by an Australian National University Research Grant.

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TWO NEW LARVAL MITES (ACARINA: ERYTHRAEIDAE) ECTOPARASITIC ON NORTH QUEENSLAND CICADAS

R.V. SOUTHCOTT

SOUTHCOTT, R.V. 1988. Two new larval mites (Acarina: Erythraeidae) ectoparasitic on north Queensland cicadas. *Rec. S. Aust. Mus.* 22(2): 103–116.

Two new larval mites are described, ectoparasitic on cicadas from Cape York Peninsula, Queensland: *Leptus torresianus* sp. nov. on *Venustria superba* Goding & Froggatt and *Tamasa doddi* Goding & Froggatt; *Caeculisoma mouldsi* sp. nov. on the same two species of cicadas and also on *Mardalana suffusa* Distant and *Psaltoda fumipennis* Ashton. *Leptus torresianus* larvae were attached to the denser chitin of the cicadas (first leg tibiae). Most *Caeculisoma mouldsi* larvae were attached to the wing veins, on both surfaces of both pairs of wings.

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Erythraeid larval mites attach as ectoparasites to a wide variety of terrestrial arthropods (insects, collembolans, arachnids) (Oudemans 1912; Southcott 1946, 1961b; Greenslade & Southcott 1980; Welbourn 1983). Various host usages of cicadas have been recorded. Ishii (1953) recorded that *Leptus kyushuensis* Ishii (Leptinae) parasitized three species in Japan: *Graptosaltria colorata* (Stål), *Meimuna opalifera* (Walker) and *Platypleura kaempferi* Matsumara; from New Zealand *Momorangia jacksoni* Southcott (Callidosomatinae) was recorded from *Melampsalta oromelaena* Meyers, and *Momorangia vallata* Southcott was recorded from *Melampsalta oromelaena* and *Melampsalta* sp. (Southcott 1972); Welbourn (1983: 138) recorded *Leptus* sp. on *Magicicada septendecim* (L.) in the United States.

Various erythraeid mite larvae have been found on other Homoptera e.g. in the families Aleyrodidae, Aphididae, Cercopidae, Cicadellidae, Delphacidae, Fulgoridae, Membracidae, Psyllidae (e.g. Oudemans 1910, 1912; Pussard & André 1929; Southcott 1946, 1961b, 1966, 1972; André 1951; Kawashima 1958, 1961a, b; Smiley 1968; Sömermaa 1973; Tseng *et al.* 1976; Yano & Ehara 1982; Welbourn 1983; Young & Welbourn 1987).

Mr M.S. Moulds, Sydney, N.S.W., observed (pers. comm. 1987) small red mites parasitizing cicadas in north Queensland, and forwarded six pinned cicadas. Five of them had dried mites attached to the legs, wings and thorax, which represent two undescribed species of Erythraeidae larvae. These are described below as *Leptus torresianus* sp. nov. and *Caeculisoma mouldsi* sp. nov. (Fig. 1 A–D shows a cicada and mites *in situ*).

Seta and other terminology follows Southcott (1961a, b, c; 1963, 1972). All measurements are in micrometres (μm) unless otherwise stated. Two new shield measurements AAS and LX are introduced here. AAS is the distance between centres of bases of AL scutala and ASens of the same side. LX is the distance of the levels of the AL scutalae behind the anteromost point of the scutum. (see Figs 2A–E). These measurements introduce a slight redundancy, since

$$AAS^2 = \left(\frac{AW\text{-}SBa}{2}\right)^2 + (ASBa\text{-}LX)^2$$

assuming perfect symmetry. Nevertheless, they appear useful in specific diagnoses of erythraeid mites.

The types of both species are deposited in the South Australian Museum.

Genus **Leptus** Latreille, 1796

For synonymy *see* Southcott (1961b: 514).

Diagnosis (for larva)

See Southcott (1961b: 514).

Remarks

This is a cosmopolitan genus, with many species having been described as adults, and others as larvae. Although in some cases correlation between larvae to deutonymphs had been recorded (Southcott 1961b: 517–521), a full correlation of a larva to the deutonymph and adult in *Leptus* (an unidentified North American species) was achieved only in 1973, by Treat (1975).

Larvae parasitise a wide variety of terrestrial arthropods (Oudemans 1912; Southcott 1961b, 1984; Treat 1975; Welbourn 1983).

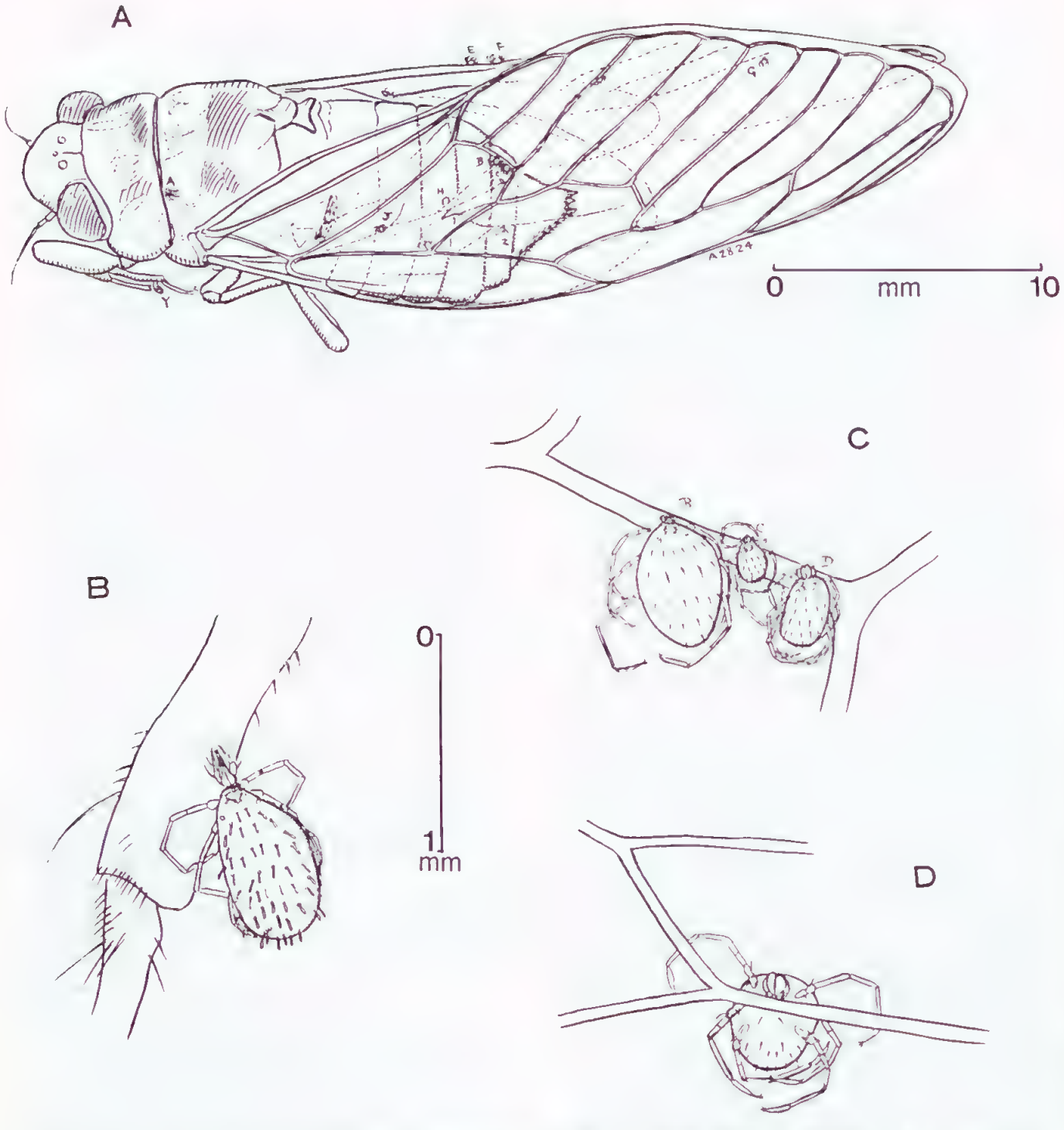

FIGURE 1. North Queensland cicada and its ectoparasitic mites. A, cicada, *Venustria superba* G. & F., A2824, preserved dry, with ectoparasitic larval erythraeid mites *in situ,* serials ACA2308, 2309. Mite Y, attached to right tibia I is *Leptus torresianus* sp. nov., holotype, ACA2308. Other mites are *Caeculisoma mouldsi* sp. nov., ACA2309 series; mite J, attached to inferior surface of left hind wing is holotype of *C. mouldsi.* B, holotype of *L. torresianus,* attached to lateral end distally of right tibia I. C, mites, *C. mouldsi,* specimens ACA2309B, C, D attached to vein of dorsal surface of left anterior wing. D, mite ACA2309Z, *C. mouldsi,* seen in transparency, attached to wing vein on inferior surface of left posterior wing. All drawings to nearest scale.

Leptus torresianus sp. nov.
(Figs 3A, B, 4A, B, 5)

Description of Larva (principally holotype, supplemented by paratypes)

Colour in dried state red. Idiosoma (mounted) of normal ovoid shape for genus, length (partially fed) 897, width 498, overall length from tip of mouthparts to posterior pole of idiosoma 1118.

Dorsal scutum moderately sclerotized, and forms approximately an equilateral triangle. Central part of its anterior border produced to a low protuberance, containing the anterior sensilla. Lateral borders short, sloping anterolaterally. Posterolateral

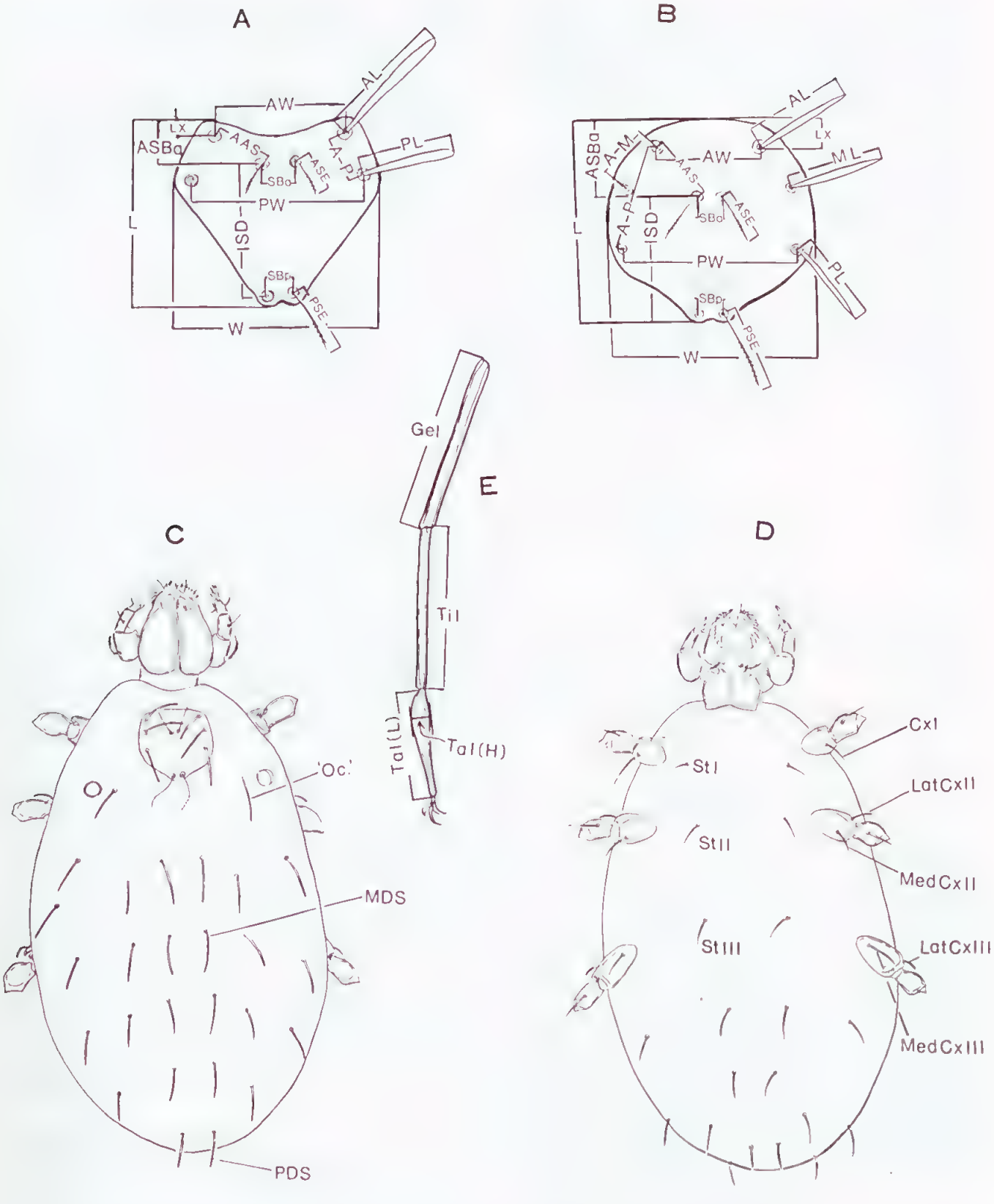

FIGURE 2. Explanatory diagrams for conventions of abbreviations and measurements used for the larval erythraeid mites. A, dorsal scutum of a larval erythraeid mite with two pairs of scutalae (*Leptus*). B, dorsal scutum of a larval erythraeid mite with three pairs of scutalae (*Caeculisoma*). C, dorsal view of *Caeculisoma* sp., with legs omitted beyond trochanters. Oc. 'ocular seta'; MDS mid-dorsal setae; PDS posterior dorsal setae.

borders concave. Posterior pole of scutum rounded, enclosed in two narrow bars of chitin not meeting in the middle. Scutal scobalae curved, blunted, a little clavate, with dense covering of short, pointed, pigmented setules. Sensillary setae filiform, with fine setules distally.

Standard and other data of scutum and legs as in Table 1.

Eyes circular, 1+1, posterolateral to scutum, 24 across.

Dorsum of idiosoma with 50 setae, slightly clavate, with pigmented but only slightly outstanding setules; setae arranged approximately 4, 6, 8, 8, 8, 8, 4, 4.

Ventral surface of idiosoma: sternalae I bushy, blunted, more or less parallel-sided, sternalae II similar, 40 long; between levels of coxae II and III are four setae, anterior pair (sternalae III) bushy, expanding, 26 long, and posterior pair (sternalae IV) more medial, bushy but more slender, 42 long.

TABLE 1. Standard data for *Leptus torresianus* sp. nov. larvae.

Character	Holotype ACA2308	Paratype ACA2311A	Paratype ACA2311B	Mean
AW	102	92	94	96
PW	114	102	108	108
SBa	15	12	13	13.3
SBp	16	15	13	14.7
LX	13	24	14	17
ASBa	9	36	16	20.3
ISD	48	39	58	48.3
L	76	73	84	77.7
W	121	111	115	115.7
AAS	42	38	40	40
A-P	16	16	19	17
AL	62	58	64	61.3
PL	*c.*65	67	67	66.3
ASE	*c.*30	31	33	31.3
PSE	*c.*60	*c.*55	46	53.7
DS	45–58	38–58	51–56	57.3*
'Oc.'	45	42	47	44.7
MDS	53	49	55	52.3
PDS	58	58	56	57.3
GeI	160	155	158	157.7
TiI	230	228	226	228
TaI(L)	162	165	—	163.5
TaI(H)	21	20	—	20.5
TiI/GeI	1.44	1.47	1.43	1.45
GeII	130	122	140	130.7
TiII	199	195	—	197
TaII(L)	140	138	—	139
TaII(H)	20	20	—	20
GeIII	155	139	155	149.7
TiIII	288	267	288	281
TaIII(L)	160	156	157	157.7
TaIII(H)	20	21	22	21
TiIII/GeIII	1.86	1.92	1.86	1.88
AW/ISD	2.13	2.36	1.62	2.04
ISD/A-P	3.00	2.44	3.05	2.83
AW/A-P	6.38	5.75	4.95	5.69
StI	42	38	44	41.3
CxI	83	73	—	78
CxII	*c.*22	25	—	23.5
CxIII	40	*c.*40	48	42.7
TiI/AW	2.25	2.48	2.40	2.38
TiIII/AW	2.82	2.90	3.06	2.93
TiIII/TiI	1.25	1.17	1.27	1.23
AW/AL	1.65	1.59	1.47	1.57
AL/AAS	1.48	1.53	1.60	1.54

*For the maxima of DS

Between and behind coxae III 16 setae, 38–50 long, arranged 4, 4, 6, 2; setae well setulose, blunted, slightly expanding, posteriors tending to be more clavate and resembling posterior dorsal idiosomalae. Coxalae 1, 1, 1, arising as figured. Coxala I parallel-sided, terminally tapering to a blunted point, and carrying many fine, pointed setules; coxalae II, III blunted, well setulose, somewhat clavate.

Legs normal; lengths (including coxae and claws) I 935, II 860, III 1015.

Leg specialized sensory setae (lengths in parentheses): SoGeI.42d(29), SoGeI.59d(29), VsGeI.92d(6). SoTiI.66d(35), SoTiI.75d(42), SoTiI.87d(25), VsTiI.89pd(5). VsGeII.91pd(9), SoTiII.04d(29), SoTiII.88d(23). SoTiIII.03d(36).

Tarsus I with SoTaI.62d(38); tarsus II with SoTaII.42d(18). Tarsal claws: anterior almost straight with terminal ventral hook; middle longest, falciform, smooth; posterior recurved, with ventral setules (*see* Fig. 3).

Gnathosoma: chelicerae with rounded posterior element to bases, smooth, tapering to long anterior projections; length 205, maximum width of bases 122; ventral surface with faint transverse striations. With two pairs of hypostomalae, pointed, nude; anterior dorsal, 20 long, posterior ventral (also near tip of hypostome) *c.* 60 long. Palpal setal formula 0, 0, 1, 1, 3, 7. Palpal femorala and genuala well setulose, tapering, pointed, not clavate, tibialae setulose. Palpal supracoxala not identified. Palpal tibial claw smooth, with a single terminal hook.

Material examined

Holotype: Queensland: C.R.E.B. [a Queensland Regional Electricity Board] Road, nr Mt Hemmant, N. of Daintree, 2.i.1984, M.S. & B.J. Moulds, in rainforest; larva attached to lateral aspect of distal end of R. tibia I of cicada *Venustria superba* Goding & Froggatt (A2824) (*see* Fig. 1A, B), N1987194 (ACA2308).

Paratypes: Mt Hartley, nr Roseville, S. of Cooktown, 1.i.1984, M.S. & B.J. Moulds; on distal end of R. tibia I of cicada *Tamasa doddi* (Goding & Froggatt) (A2826), two larvae N1987195 and N1987196 (ACA2311A, B).

Remarks on taxonomy

Leptus torresianus sp. nov. is placed in the group of *Leptus* larvae with one femoral seta and one genual seta on the palp, which includes the majority of described members of the genus. However it differs from all described larvae with the preceding character set in having two specialized sensory setae (spinalae or solenoidalae) on leg genu I. All others of this group have only one spinogenuala, except *L. stieglmayri* (Oudemans, 1905) from Brazil, which has five (Oudemans 1912: 165). Some other *Leptus* larvae have two or more such setae on genu I, but they also have two palpal femoral setae (scobalae) — these being *L. echinopus* Beron, 1975, from Bulgaria, with five spinalae on genu I, and *L. southcotti* Beron, 1975, from Bulgaria, with two spinalae on genu I.

Remarks on biology

Leptus larvae appear generally to prefer hard, heavily chitinized parts of their hosts on which to attach by their mouthparts e.g. tibia in the case of *L. torresianus.* Treat (1975: 224) has also commented on this preference of an unnamed North American larval *Leptus* for an externally exposed sclerotized area: 'There is no seeking of soft membranes or crevices'. They are presumably able to utilize a small apparently mobile tooth on the tip of the cheliceral digits (*see* Fig. 4B) as a gouging or boring piece.

Etymology

The specific name is from the Torresian region of northern Australia.

Genus **Caeculisoma** Berlese, 1888

For synonymy *see* Southcott (1961b: 524, 1972: 25).

Diagnosis (for larva)

See Southcott (1972: 25).

Caeculisoma mouldsi sp. nov.
(Figs 6A–C, 7A, B, 8)

Description of larva (principally from holotype, supplemented by paratypes)

Colour in dried state red. Idiosoma (mounted) of normal ovoid shape, length (partially fed) 600; width 385; overall length from tip of mouthparts to posterior pole of idiosoma 710.

Dorsal scutum approximately oval, with slightly concave anterior margin and rounded anterolateral angles. Anterolateral borders almost straight; posterolateral borders evenly rounded. Posterior sensillary bosses protrude a little at posterior pole of scutum. Scutalae curved, tapering, blunted, lightly setulose with adnate setules. Sensillary setae filiform, with a few distal setules.

Standard data as in Table 2.

Eyes 1+1, circular, 22 across.

Dorsal idiosoma setae curved, tapering, pointed, with a few adnate setules; arranged 2, 7, 6, 6, 4, 4, total 29.

Ventral surface of idiosoma: sternalae curved, tapering, pointed, with a few setules; II 40 long, III 36. Behind coxae III about 12 similar setae, 33–38 long, arranged 4, 4, 2, 2. Coxala I slender, tapering,

FIGURE 3. *Leptus torresianus* sp. nov., larva, holotype. A, dorsal view, legs omitted beyond trochanters. B, palpal tibia and tarsus, dorsal view. (Each to nearby scale.)

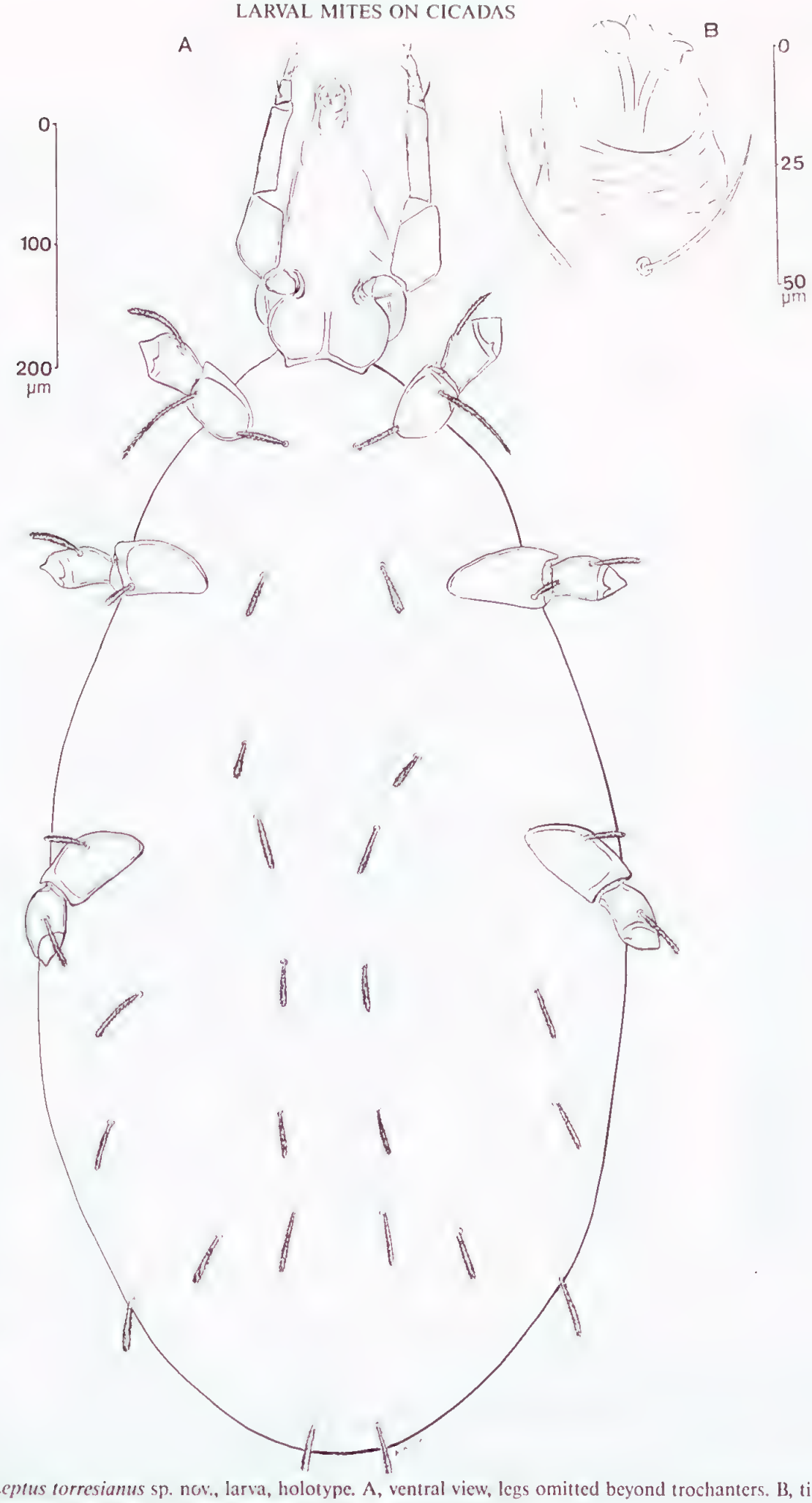

FIGURE 4. *Leptus torresianus* sp. nov., larva, holotype. A, ventral view, legs omitted beyond trochanters. B, tip of gnathosoma, ventral view. (Each to nearby scale.)

TABLE 2. Data on larvae of *Caeculisoma mouldsi* sp. nov.

Character	Holotype	n	range	mean	s.d.	c.v.
AW	68	43	58–75	68.33	3.3432	4.8931
MW	77	43	72–82	77.16	2.7683	3.5876
PW	76	45	69–80	76.11	2.4423	3.2088
SBa	9	46	7–11	9.13	0.9800	10.7333
SBp	14	48	11–15	13.81	0.9600	6.9500
LX	7	38	5–9	6.24	1.1954	19.1660
ASBa	29	38	24–33	28.50	2.3452	8.2288
ISD	61	41	48–66	57.24	3.4408	6.0108
L	95	38	84–100	92.21	3.9808	4.3170
W	96	44	87–101	93.25	3.1852	3.4157
AAS	35	41	34–41	36.00	1.3038	3.6218
A-M	17	46	14–22	17.50	1.9061	10.8922
A-P	45	46	37–50	43.63	2.9010	6.6491
AL	54	33	35–56	48.18	5.2408	10.8771
ML	58	41	44–64	53.90	5.1176	9.4943
PL	56	45	38–56	47.18	4.1522	8.8011
ASE	44	44	35–49	41.59	3.1425	7.5557
PSE	67	41	55–68	63.37	3.0146	4.7574
DS	40-63	50	47–64*	56.43	4.0466	7.1712
Oc.	63	49	47–64	56.61	4.0353	7.1280
MDS	55	50	38–57	46.04	3.6809	7.9951
PDS	55	50	42–55	47.36	3.2561	6.8753
GeI	147	51	131–153	142.75	4.9673	3.4798
TiI	201	50	175–206	186.70	7.0138	3.7567
TaI(L)	154	50	129–155	144.16	5.8322	4.0457
TaI(H)	18	50	16–22	18.60	1.3401	7.2049
TiI/GeI	1.37	49	1.17–1.39	1.3018	0.0491	3.7719
GeII	140	51	122–142	131.06	5.0296	3.8376
TiII	174	51	156–182	169.14	5.5462	3.2791
TaII(L)	147	51	131–151	140.43	4.1533	2.9576
TaII(H)	18	51	16–21	18.59	1.0035	5.3987
TiII/GeII	1.24	51	1.19–1.35	1.2906	0.0418	3.2374
GeIII	157	50	140–165	151.10	5.8910	3.8988
TiIII	259	51	240–279	255.96	9.7118	3.7942
TaIII(L)	156	51	137–164	152.84	5.5834	3.6531
TaIII(H)	16	51	14–18	16.35	0.9343	5.7134
TiIII/GeIII	1.65	50	1.58–1.86	1.6942	0.0615	3.6309
AW/ISD	1.19	39	1.03–1.44	1.1941	0.0857	7.1750
ISD/A-P	1.36	41	1.16–1.53	1.3159	0.0814	6.1857
AW/A-P	1.51	38	1.30–1.86	1.5621	0.1211	7.7539
StI	29	28	27–38	31.43	3.7061	11.7923
CxI	49	40	37–58	49.75	4.1618	8.3654
LatCxII	38	48	26–40	34.94	3.1244	9.1560
MedCxII	45	42	36–53	45.19	3.1487	6.9675
LatCxIII	33	42	25–38	32.07	3.6519	11.3867
MedCxIII	49	41	36–49	43.78	3.4894	7.9701
TiI/AW	2.96	42	2.46–3.05	2.7305	0.1491	5.4640
TiIII/AW	3.81	43	3.35–4.26	3.7614	0.2244	5.9670
AW/AL	1.26	28	1.20–1.97	1.4218	0.1881	13.2264
AL/AAS	1.54	29	0.97–1.62	1.3500	0.1498	11.0988

*For maxima of these setae

pointed, with a few setules. Lateral coxala II curved, blunted, lightly setulose, lateral III similar; medial coxalae II, III as described for coxala I.

Legs normal; lengths (including coxae and claws): I 790, II 750, III 915.

Leg specialized sensory setae (lengths in parentheses): SoGeI.85d(36), VsGeI.90pd(5). SoTiI.65d(60), CpTiI.73d(7), SoTiI.74d(55), VsTiI.87pd(5). VsGeII.92pd(5). SoTiII.07d(51), SoTiII.79d(27). SoTiIII.06d(50).

Tarsus I with SoTaI.33d(48); long, tapering, pointed. Tarsus II with SoTaII.43d(31), terminally expanding a little, blunted. Tarsal claws as for genus, all falciform. The posterior tarsal claw is somewhat obtusely-angled about halfway along, with a few ventral setules.

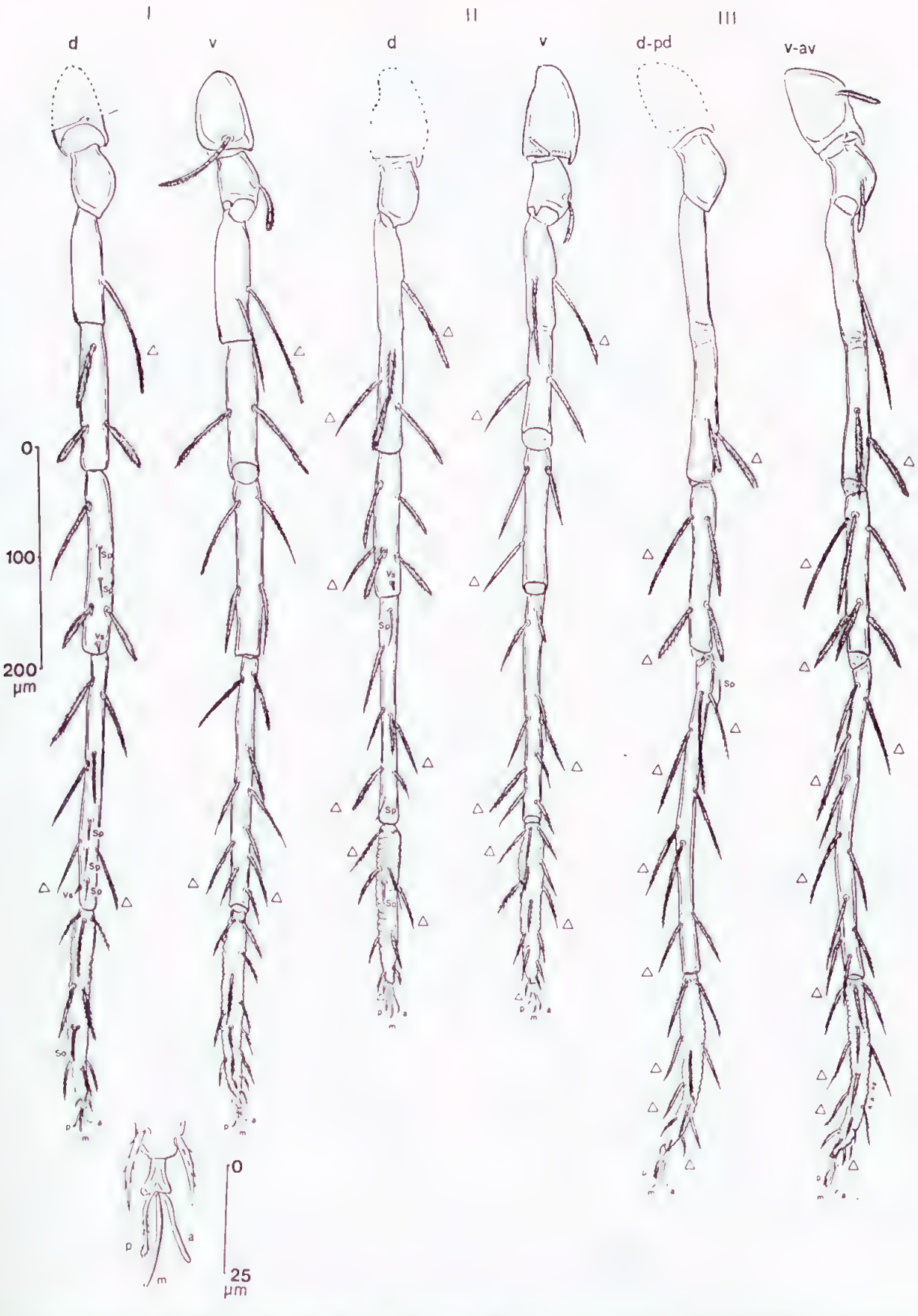

FIGURE 5. *Leptus torresianus* sp. nov., larva, holotype. Legs I, II, III, to standard symbols. Inset: tip of tarsus I, dorsal view. The symbol Δ indicates that the seta is shown in both drawings of the leg or other structure. a, m, p indicate anterior, middle and posterior tarsal claws, respectively. Vs vestigiala. So is used for tarsal solenoidala, Sp for other leg solenoidala (spinala), as in author's terminology.

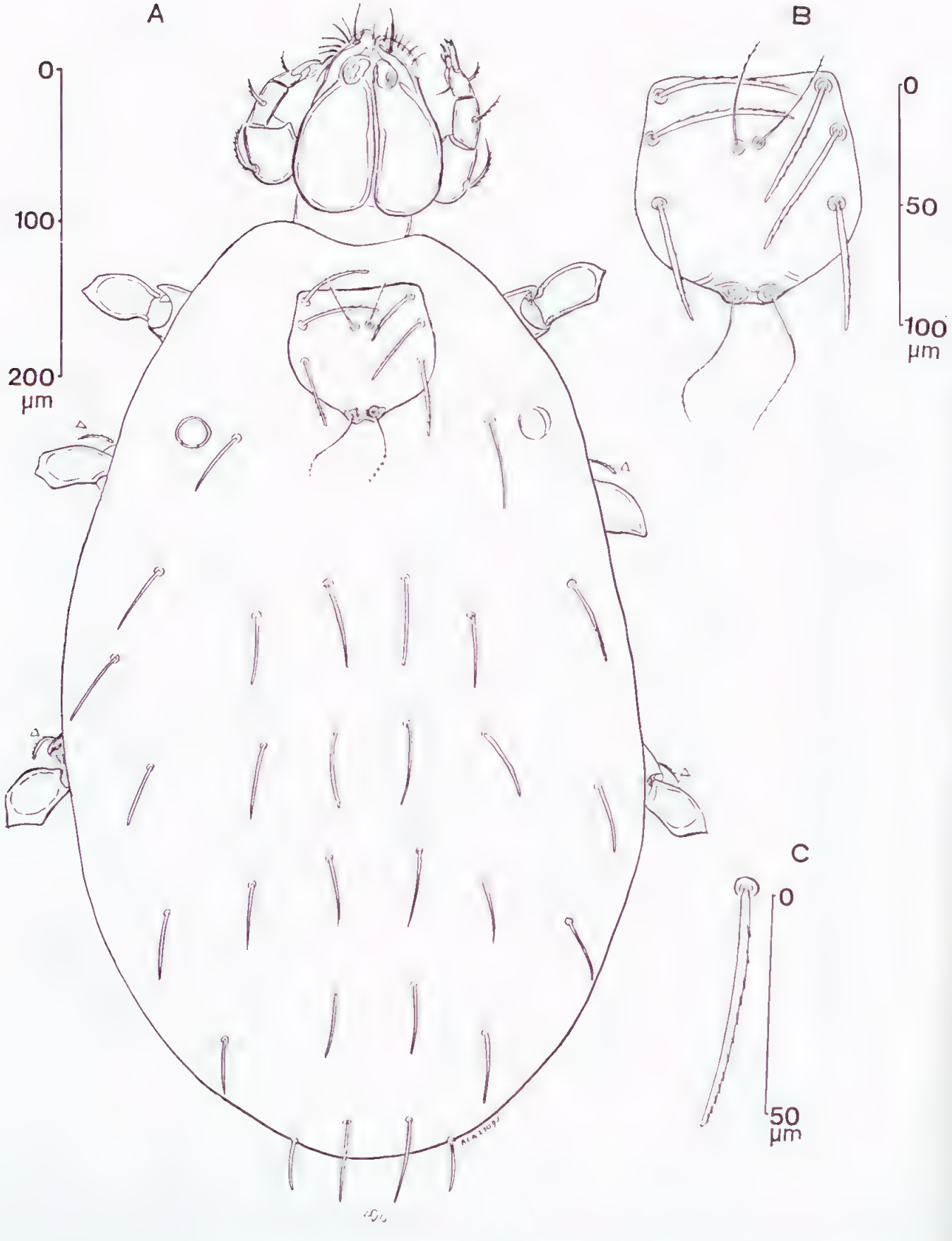

FIGURE 6. *Caeculisoma mouldsi* sp. nov., larva, holotype. A, dorsal view, legs omitted beyond trochanters. B, dorsal scutum. C, dorsal idiosomal seta. (Each to nearest scale.)

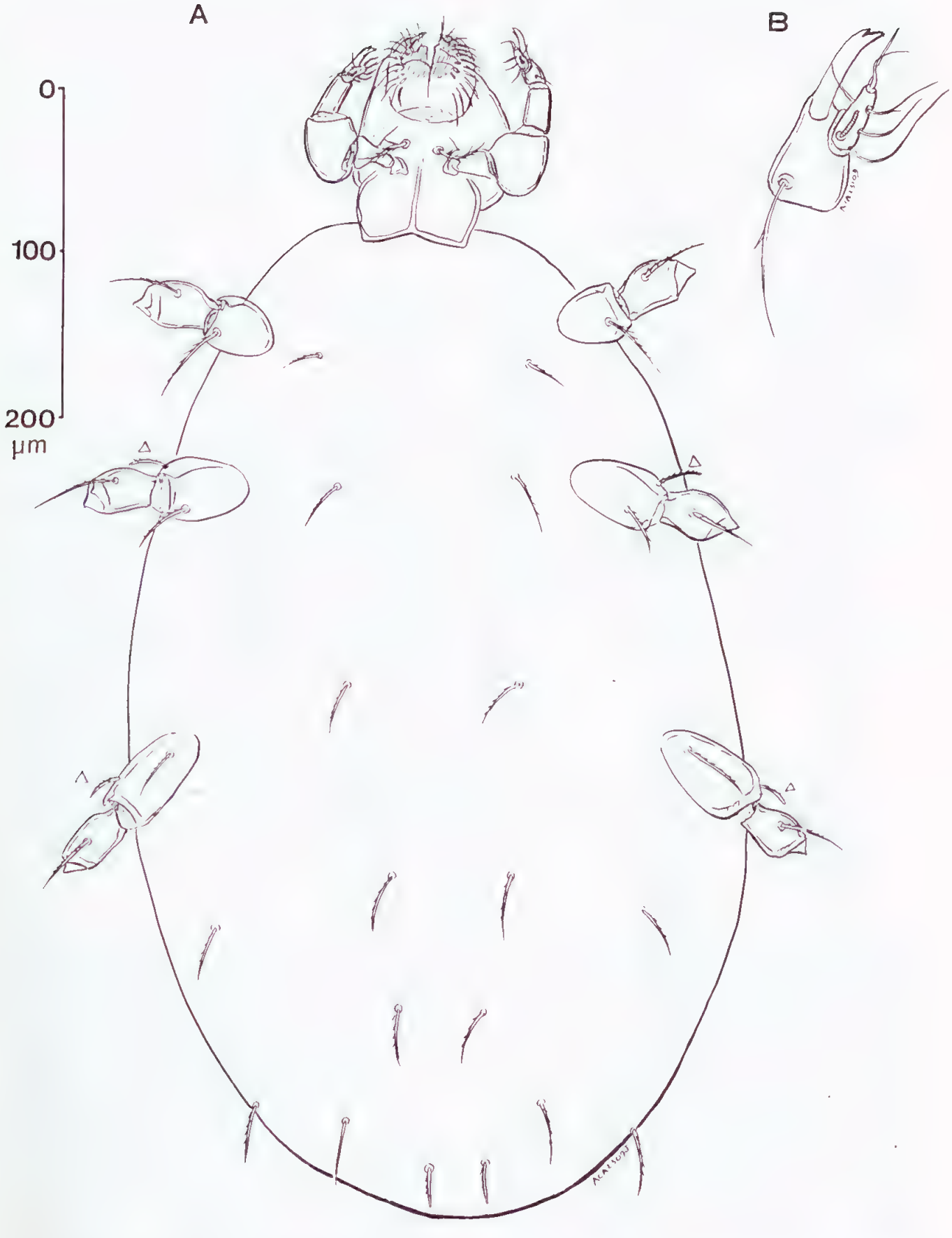

FIGURE 7. *Caeculisoma mouldsi* sp. nov., larva, holotype. A, ventral view, legs omitted beyond trochanters. B, palpal tibia and tarsus, ventral view, from paratype ACA2310D (not to scale).

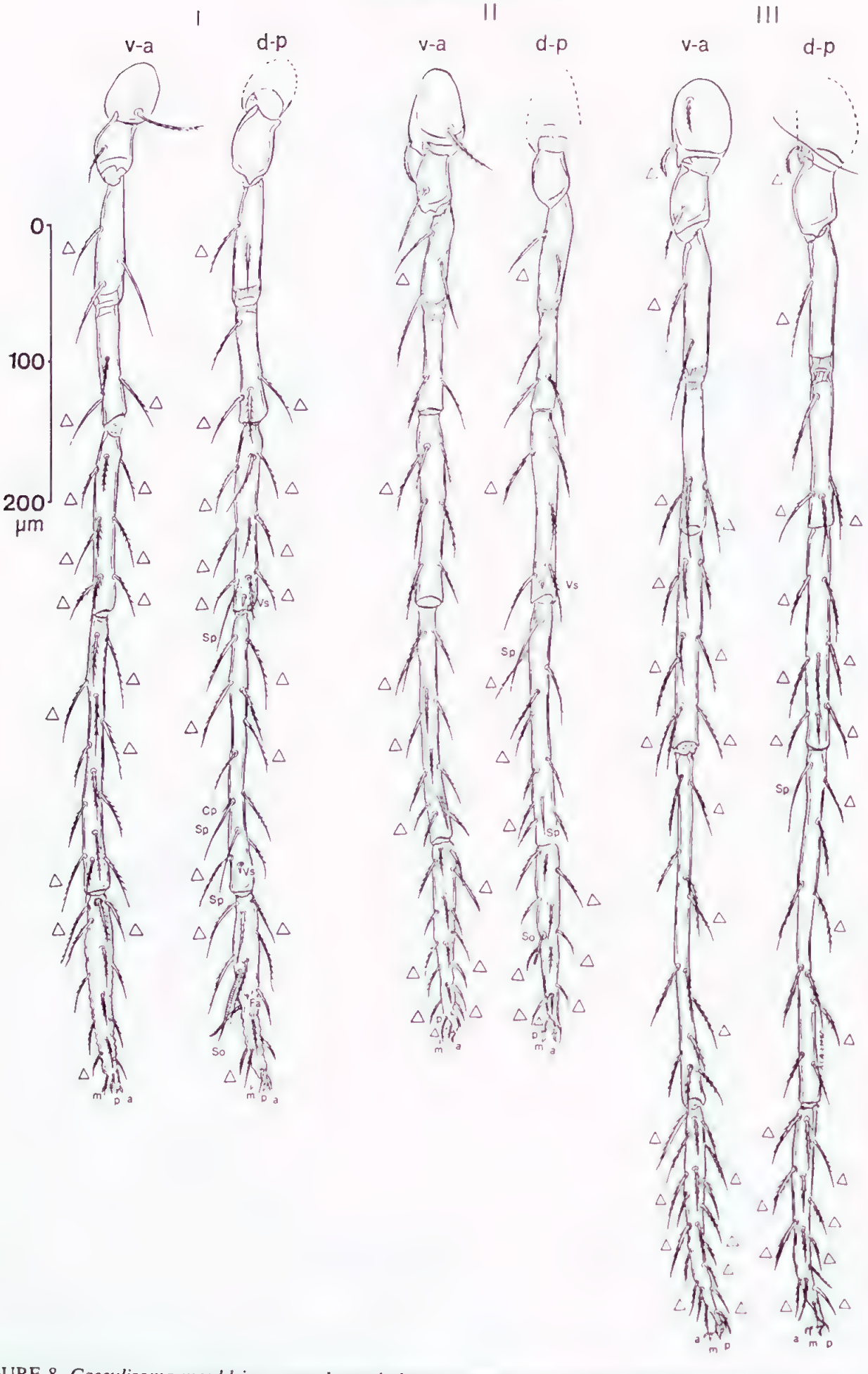

FIGURE 8. *Caeculisoma mouldsi* sp. nov., larva, holotype. Legs I, II, III, to standard symbols, as in Fig. 5; Cp companala; Fa famala.

Gnathosoma: cheliceral bases pyriform, smooth, 120 long by 93 wide (combined). Galeala smooth, simple, pointed, 27 long. Hypostomala arises anterior to palpal trochanters, 40 long, with several long setules. Palpal setal formula 0, 0, 1, 1, 3, 7. Palpal femorala tapering, pointed, well setulose, *c.* 42 long. Palpal genuala tapering, pointed, 27 long, with a few setules. Palpal tibialae pointed, with a few setules. Palpal tibial claw bifid, the dorsal tine weak. Palpal tarsus as figured. Gnathosomal supracoxala a blunted peg, 4 long.

Material examined

Holotype: Queensland: C.R.E.B. Road, nr Mt Hemmant, N. of Daintree, 2.i.1984, M.S. & B.J. Moulds, in rainforest, on wing of cicada *Venustria superba* G. & F (A2824), larva N1987197 (ACA-2309J).

Paratypes: Same data as holotype, nine larvae N1987198–N1987206 (ACA2309A–D, H, K–N). Mt Hartley, nr Roseville, S. of Cooktown, 1.i.1984, M.S. & B.J. Moulds, on *Venustria superba* G. & F. (A2825), 27 larvae N1987207–N1987233 (ACA-2310A–Z, ZA). Same locality, date and collectors, on cicada A2826 *Tamasa doddi* (G. & F.), two larvae N1987234, N1987235 (ACA2312A, B). Same locality, date and collectors, on cicada A2827 *Mardalana suffusa* Distant, nine larvae N1987236–N1987244 (ACA2313A–I). Same locality, date and collectors, on cicada A2829 *Psaltoda fumipennis* Ashton, three larvae N1987245–N1987247 (ACA2314A–C).

Remarks on distribution and taxonomy

Caeculisoma was founded by Berlese (1888: 186) on two adult mites referred to *C. tuberculatum* Berlese, 1888, one collected under decomposing fungi at Buenos Aires, Argentina, and the other from under tree bark at Asunción, Paraguay. Correlation with the larva was established by Southcott (1961a, b) for the Australian *C. darwiniense* Southcott, 1961. The species are known only from Southern Hemisphere locations, and larvae have been described only from Australia and New Zealand. *C. darwiniense* is known from Northern Territory, Queensland, New South Wales, South Australia and Western Australia, recorded hosts being Acrididae (Orthoptera); *C. cooremani* Southcott, 1972, is known from Western Australia (Acrididae); *C. huxleyi* Southcott, 1972, is recorded from New Zealand, parasitizing *Xanthorhoe* sp. (Lepidoptera: Geometridae). *C. mouldsi* sp. nov. is known only as larvae from a limited area of tropical Australia (Cape York Peninsula), parasitic on cicadas.

For a discussion on the generic classification of the tribe Callidosomatini, see Treat (1985) and Southcott (1988).

In the key to the larvae of *Caeculisoma* (Southcott 1972: 25–26), *C. mouldsi* comes down to caption (3), which may be replaced by:

3 (2) PD setae in range 20–30μm long .... *C. sparnoni* Southcott
PD setae in range 40–90μm long 4
4 (3) PD setae in range 40–60μm long .... *C. mouldsi* sp. nov.
PD setae in range 70–90μm long .... *C. huxleyi* Southcott (New Zealand)

Etymology

The species is named for the collectors.

ACKNOWLEDGMENT

I thank the Australian Biological Resources Study for support.

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REVISION OF AUSTRALASIAN *HYDROPHILUS* MULLER, 1764 (COLEOPTERA: HYDROPHILIDAE)

C.H.S. WATTS

WATTS, C.H.S. 1988. Revision of Australian *Hydrophilus* Muller, 1764 (Coleoptera: Hydrophilidae). *Rec. S. Aust. Mus.* 22(2): 117–130.

The genus *Hydrophilus* Muller in Australia, New Guinea and New Caledonia is revised and descriptions given for each of the 11 species recognised, three of which are new (*H. novaeguineae, H. viridis* and *H. infrequens*). The following new synonomys are proposed: 1) *Hydrophilus picicornis* (Chevrolat, 1863) = *Hydrophilus gayndahensis* Macleay, 1871 = *Hydrophilus sabelliferus* Fairmaire, 1879 = *Stethoxus sabellifer* Bedel, 1891: 2) *Hydrophilus brevispina* Fairmaire, 1879 = *H. scissipalpus* Blackburn, 1901: 3) *Hydrophilus loriai* (Regimbart, 1902) = *Hydrous gebieni* Knisch, 1922a. A key to species is provided.

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Among the most prominent of Australian water beetles are the large black species of Hydrophilidae which belong to the world-wide genus *Hydrophilus* Muller 1764 (see Balfour-Browne 1941, and Pope 1985, for discussion of the use of this name for the genus). They are common in collections although they are seldom abundant in any one water body. An exception occasionally occurs in drying inland pools when both adults and larvae of some species can be found in large numbers.

The Australasian species have been revised and keys which include the Australasian species have been produced by Bedel (1891), and Regimbart (1902). But these studies were based on the examination of the relatively few specimens available in Europe at the time with the result that variation within species is underestimated. Conversely the lack of type material in Australia has led to misidentifications being perpetuated. As a result material in Australian collections is usually poorly identified.

My studies have shown that there are seven endemic species in Australia, one in New Caledonia and two in New Guinea. In addition the common Indonesian species, *H. picicornis,* occurs widely in New Guinea and eastern Australia.

Hydrophilus is a world wide genus. Because of this I have made no attempt to think cladistically about the Australasian species. Suffice to say that phenotypically they fall into three groups. The largest group, characterised by a short stout sternal spine and little abdominal pubescence, comprises *H. latipalpus, H. pedipalpus, H. macronyx, H. australis, H. novaeguineae, H. albipes,* and *H. brevispina.* A second group, comprising *H. picicornis* and *H. loria* and characterised by a very long sternal spine and completely pubescent sternal segments, is part of a large group of Asian species. The final group comprises two new species, *H. viridis* and *H. infrequens,* which have a short sternal spine and the sides of the abdominal sternae broadly pubescent; they are also smaller and stouter than most *Hydrophilus,* resembling *Hydrobiomorpha* Blackburn in general shape.

Both adult and larval *Hydrophilus* are aquatic. The larvae are large, fleshy and carnivorous, living and hunting among the weeds at the edges and bottom of shallow ponds. Although frequently collected, no larvae of Australian species have yet been described.

Diagnostic characters of the genus *Hydrophilus* are; large (21–46 mm), prominent keel on underside produced backwards into a spine of varying length, apical margin of clypeus complete, prosternum deeply sulcate (hood-like) posteriorly to receive apex of sternal keel.

Specimens were examined from the following collections:

AM	Australian Museum, Sydney
ANIC	Australian National Insect Collection, CSIRO, Canberra
BMNH	British Museum (Natural History), London
CW	Private collection of author
MNHP	Museum National d'Histoire Naturelle, Paris
NMV	Museum of Victoria, Melbourne
NTM	Northern Territory Museum and Art Gallery, Darwin
EUQ	Entomology Department, University of Queensland
QDPI	Queensland Department of Primary Industries, Mareeba
QM	Queensland Museum, Brisbane
SAMA	South Australian Museum, Adelaide
WAM	Western Australian Museum, Perth

SYSTEMATICS

KEY TO AUSTRALASIAN *HYDROPHILUS*

1 — Tip of sternal carina reaching beyond 2nd abdominal segment, abdominal segment

entirely pubescent 2
— Tip of sternal carina not reaching beyond 2nd abdominal segment, abdominal segments with at least central portions non-pubescent 3

2(1) — Front portion of sternal carina wide, broadly sulcate (Fig. 4) *loriai* (Regimbart)
— Front portion of sternal carina narrow, narrowly sulcate (Fig. 5) ..... *picicornis* (Chevrolat)

3(1) — Abdominal segments with all but central portions pubescent, small (18–25 mm), often olive-greenish 10
— Abdominal segments only pubescent in front angles, usually larger (20–46 mm) 4

4(3) — Tip of elytron distinctly spined, tip of sternal carina reaching to second abdominal segment, groove on front edge of pronotum reaching past level of inner edge of adjacent eye ..... *australis* Montrouzier
— Tip of elytron rounded or weakly spined. Tip of sternal carina usually not reaching second abdominal segment, groove on front edge of pronotum variable ... 5

5(4) — Rugose area on front edge of 1st abdominal segment < ⅓ length of segment, metafemur robust 6
— Rugose area on front edge of 1st abdominal segment ½–⅔ length of segment 8

6(5) — Spine on underside of claw on protarsi of female in middle of claw, labial palpi thickened particularly in male, claws on protarsi of male enlarged, somewhat flattened, outer twice size of inner (Fig. 14)..... *novaeguineae* sp. nov.
— Spine on underside of claw of protarsi of female towards base of claw, labial palpi normal, outer claw on protarsi of male either grossly enlarged or thin and not flattened (Figs 10 & 16) 7

7(6) — Large (34–40 mm), groove along front edge of pronotum usually short, confined to extreme sides, protarsal claws of male greatly enlarged, spade-like, punctures on outer face of protibia sharply impressed ..... *macronyz* (Regimbart)
— Small (27–35 mm), groove along front edge of pronotum usually reaching to level of inner border of eye, protarsal claws of male subequal but only slightly enlarged, punctures on outer face of protibia weak ..... *brevispina* Fairmaire

8(4) — Smaller (21–30 mm), row of stout setae on outer face of protibia to about ½ length of tibia, male maxillary palpi of male simple ..... *albipes* Castelnau
— Larger (30–46 mm), row of stout setae on outer face of protibia more than ⅔ length of tibia, male maxillary palpi of male enlarged 9

9(8) — Elytral striae relatively weak, sternal carina in male deeply grooved in front, flat in female, male antenna with first and second joint greatly expanded, maxillary palpi in male expanded ..... *pedipalpus* (Bedel)
— Elytral striae well marked, particularly towards apex, sternal carina of male flat, in female with rounded downward extention at anterior apex, apex of elytron rounded or squared off, male antenna with moderately expanded second segment, maxillary palpi in male normal ..... *latipalpus* Castelnau

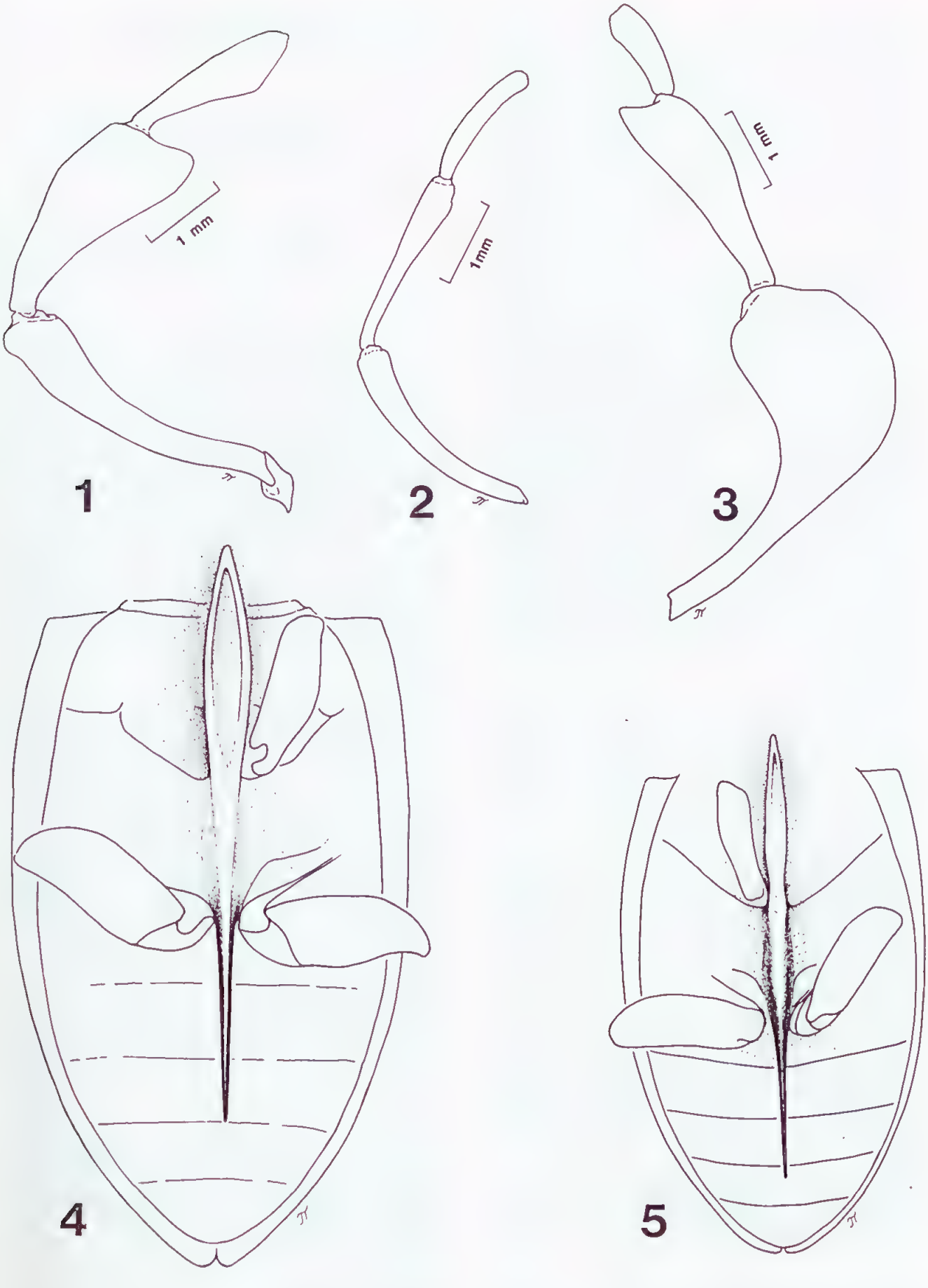
10(3) — Small (18–21 mm), light olive green when dry, inner edges of rugose areas on abdominal segments 2 and 3 not adjacent, giving saw-toothed pattern ..... *viridis* sp. nov.
— Large (23–25 mm), dark olive-green or reddish black when dry, inner edges of rugose areas on abdominal segments 2 and 3 approximately adjacent ..... *infrequens* sp. nov.

Hydrophilus macronyx (Regimbart)

Stethoxus macronyx Regimbart, 1902, p. 194.
Hydrous macronyx (Regimbart), Knisch, 1924, p. 249.

Description (number examined 11)

Length 34–39 mm. Oval. Dark olive-green to black, appendages lighter, reddish with well marked yellowish spots at side of each abdominal segment. Most of emarginate area on clypeus and membranous area of hind edge of abdominal segments 3–4 yellowish. Head with clypeus widely emarginate, 60–80 large punctures on frons area, densely covered with small punctures of two sizes, the smaller greatly predominating.



FIGURES 1–5. 1, maxillary palpus of male *H. latipalpus*; 2, *H. brevispina*; 3, ditto *H. pedipalpus*; 4, sternal keel of holotype of *H. loriae*; 5, ditto of *H. picicornis* (holotype of *H. sabelliferus*).

Pronotal punctures as on head, with a distinct groove around lateral edge, except near exterior hind angle, extending for only a short distance along front margin, some large punctures towards side. Elytron punctured as on head with four longitudinal rows of scattered large punctures in weak grooves, flanked on each side by row of very small punctures, traceable over whole elytron, a little more developed towards apex where they remain much smaller than punctures in main rows. Apex of elytron smoothly rounded. Sternal carina flat, with narrow grove on hind section, well marked short carina on surface between mesocoxae, spine short, blunt reaching to little more than ½ way across first abdominal segment. Prosternal pillar wide, scoop-like with quite deep groove for reception of sternal carina. Lateral plate of mesosternum short, broad. Metatibia very broad, much larger than width of 2nd abdominal segment. Metacoxal plates not particularly narrow, about same width as 3rd abdominal segment. Pilose portion of 1st abdominal segment reaches about ¼ way across segment. Pilose portions of sides of other abdominal segments about ⅓ width of segment. Hind edge of 1st abdominal segment with some well marked punctures. Abdominal segment weakly roofed in midline. Groove around edge of apical abdominal segment complete except for small portion at tip.

Female: protarsi not expanded [segment 5 > (2 > 3 = 4 = 1) in length].

Male: protarsi as in Fig. 16. Segment 5 massively expanded especially on bottom front edge, behind this flap is a row of stout setae; segment 4 and to a lesser degree segment 3 with elongate triangular expansion in same plane as segment 5 [5 > > (1 = 2 = 3 = 4) in length]. Outer claw massive, flatly expanded, almost as large as segment 5, inner claw greatly expanded, parallel-sided and flattened. 1st segment of lapial palpi a little stouter than in female. Parameres narrow, bent, hooked at tip. Aedeagus short narrow, spermathecal opening very wide, beyond middle.

Type

Stethoxus macronyz Regimbart. Rockhampton, in MNHP. One of two specimens used by Regimbart but not specifically designated as the Type. Herein designated lectotype.

Distribution (Fig. 17)

Known only from coastal regions of Northern Territory and Cape York.

Remarks

A large species readily recognised from the other large Australian species, *H. pedipalpis* and *H. latipalpus,* by the robust metafemurs and the greatly enlarged spade-like claws on the male protarsi. Separated from *H. novaeguineae* by characters given under that species.

Additional localities

N.T. — Darwin AM, Oenpelli NMV, SAMA, NTM. QLD — Pt Denison AM, Tolga QDPI, Yirrkala AM.

Hydrophilus picicornis Chevrolat

Hydrophilus ruficornis Boisduval, 1835, name preoccupied by *Hydrophilus ruficornis* Klug, 1833). *Hydroporus picicornis* Chevrolat, 1863, p. 204; *Stethoxus picicornis* (Chevrolat), Bedel, 1891, p. 316; Kuwert, 1893, p. 91; Regimbart, 1902, p. 203; Knisch, 1922b, p. 2; Knisch, 1924, p. 256. *Hydrophilus gayndahensis* Macleay, 1871, p. 124, syn. nov.; Blackburn, 1901, p. 129. *Hydrous gayndahensis* (Macleay), Kuwert, 1893, p. 92; Knisch, 1924, p. 248. *Hydrophilus sabelliferus* Fairmaire, 1879, p. 80. syn. nov. *Hydrous sabelliferus* (Fairmaire), Knisch, 1924, p. 248. *Stethoxus sabellifer* Bedel, 1891, p. 316. syn. nov. (unjustified emendation of *sabelliferus* Fairmaire); Regimbart, 1902, p. 204. *Hydrous sabellifer* (Bedel), Knisch, 1924, p. 248.

Description (number examined 233)

Length 21–32 cm. Elongate oval. Dark olive green to black, appendages of head and a diffuse spot laterally on each abdominal segment reddish-brown. Head with clypeus relatively weakly emarginate; 40–60 large punctures in frons area, densely punctured with small punctures of two sizes, the smaller more numerous and minute. Pronotum punctured as on head, with a distinct groove around lateral edge, except for hind angle, and along front to about ¼ width of pronotum on either side; a few very large punctures towards sides. Elytron with very fine reticulation but virtually lacking punctures other than the following except for some very small ones towards apex. Four distinct rows of even punctures, the 1st, 2nd and 4th, to a lesser degree, with punctures close together, the 3rd with only a few sparse punctures. Each row flanked on each side by a row of very small punctures only visible in certain lights. Apex of elytron truncated with or without a small blunt spine on sutural angle. Sternal carina thin, weakly and widely grooved in front portion, hind portion with slight thin groove, spine greatly elongated, sharp, reaching to hind ½ of 3rd segment with tendency to bend downwards towards tip. Prosternal pillar squat, deeply and narrowly grooved for reception of sternal carina. Metacoxal plate a little narrower than metatibia. Metatibia

about width of 2nd abdominal segment. Pilose area on underside completely covering abdominal segments, occasionally some thicker golden hairs in midline.

Female: protarsi not expanded [segment 5 > = 2 > = (1 = 3 > 4) in length].

Male: protarsi as in Fig. 9. Fifth segment weakly expanded almost equal in length to 2nd. Claws narrow, curved, outer considerably larger than inner [segment 5 < < (2 > > 3 > 4 = 1) in length]. Parameres elongate, thin, aedeagus thick at base, rapidly tapering at tip. Spermathecal duct opening near tip.

Types

Hydrophilus gayndahensis Macleay. There are two specimens in the ANIC (on permanent loan from the Macleay Museum) from Gayndah labelled as syntypes. One is a male in good condition, the other has lost most of its tarsi. In addition there are two specimens in AM each labelled 'Holotype'. Presumably these are the specimens designated by McKeown 1948. One, without locality and labelled only 'K19395' is a specimen of *H. albipes*, the other with the same number is labelled '*Hydrophilus gayndahensis* Gayndah' and is a specimen of *H. gayndahensis*. I feel reasonably certain that the true holotype is among these specimens and herein designate the specimen labelled '*Hydrophilus gayndahensis* Gayndah' in AM as the lectotype and the Macleay Museum specimens as paralectotypes.

Hydroporus picicornis Chevrolat. Not located. Type locality given as Cuba by Chevrolat but this locality has been discounted by most authors (cf. Bedel 1891; Knisch 1924).

Hydrophilus ruficornis Boisduval. Not located. Type locality, 'Nouvelle Hollande'. It is possible that this is the same insect as *H. picicornis*. It is however an occupied name having been used in 1833 by Klug for a Madagascan species.

Hydrophilus sabelliferus Fairmaire, male, labelled 'Hydrophil sabelliferus Fairm L. Viti-leon' from collection Leon Fairmaire 1906, in MNHP. I herein designate it lectotype since it is unclear whether this is a holotype or a syntype. Synonymy based on examination of types and description of *H. picicornis*.

Remarks

Readily recognisable from all other Australasian *Hydrophilus*, except *H. loriai*, by long sternal carina, which reaches ½ length of abdomen, and by the abdominal segments completely covered by pilosity; separated from *H. loriai* by characters given under that species.

Distribution

Coastal Australia from the Kimberly to northern New South Wales (Fig. 17), New Guinea and other islands to north of Australia.

A widespread species through Indonesia, New Guinea, Pacific Islands and northern Australia. I have not seriously studied the northern or western geographic boundaries of this species but consider specimens seen from Vietnam and the Philippines should be included. There is a north-south trend in size with specimens from Sulawesi and the Philippines averaging considerably larger than those from Australia.

Additional Localities

W.A. — Drysdale R. ANIC, Mitchell Plateau ANIC. QLD — Ayr ANIC, Biggenden ANIC, Brisbane ANIC, BMNH, Bundaberg ANIC, Cairns ANIC, Cooktown QDPI, Edungalba ANIC, Ingham ANIC, Innisfail QDPI, Iron Range ANIC, Lamington Nat. Pk ANIC, Marreeba QDPI, Mt Spec ANIC, Nambour ANIC, Ravenshoe ANIC, Rockhampton ANIC, AM, Samford ANIC, Tolga QDPI, Tully ANIC. N.T. — Adelaide R. NTM, Cobourg Pen. ANIC, Daly River Crossing ANIC, Daly R. SAMA, Darwin ANIC, Gove NMV, Humpty Doo QDPI, Jabiru NTM, Koongarra ANIC, Mt Cahill ANIC, Nabarlek Dam ANIC, Nourlangie ANIC, NMV, 120° 34′S 131° 18′E NTM. N.S.W. — Bonville ANIC, Iluka AM, Kempsey ANIC, SAMA, Lismore AM, Macleay R. ANIC, Pt Macquarie AM, Repton AM. A.C.T. — Black Mt ANIC. Other — Fiji BMNH, Finesterre Mts (P.N.G.) BMNH, Java SAMA, 90 km W Lae (P.N.G.) BMNH, Mimika R. (P.N.G.) BMNH, Pt Moresby (P.N.G.) BMNH, Pt Yiperres (P.N.G.) BMNH, Sulawesi BMNH.

Hydrophilus loriai (Regimbart)

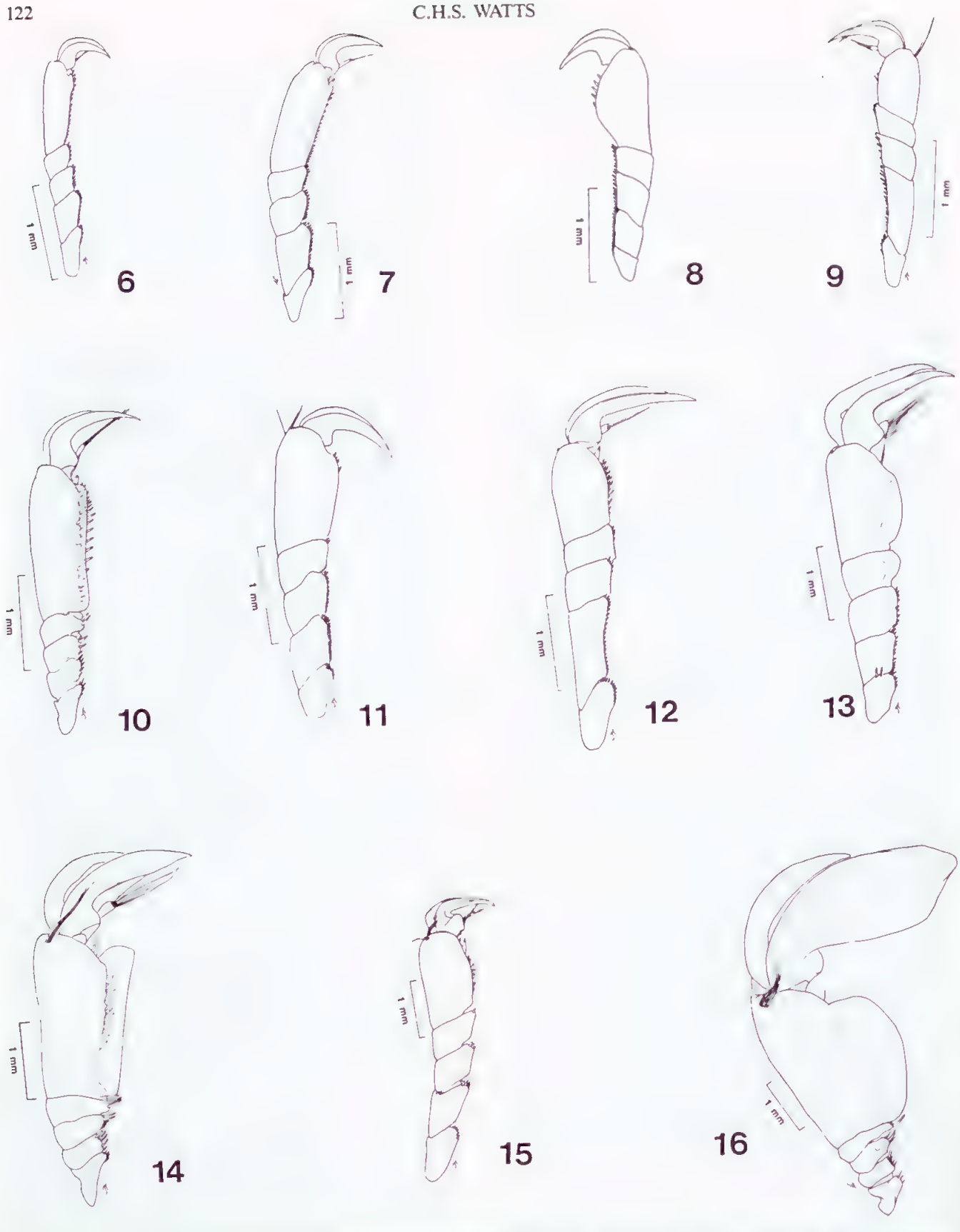
Stethoxus loriai Regimbart, 1902, p. 193.
Hydrous gebieni Knisch, 1922, p. 108, syn. nov.

Description (number examined 9)

Length 31–33 mm. As for *H. picicornis* except as follows. Generally larger. Apex of elytron backcut towards sutural edge which usually has a small but well-marked spine. Sternal carina broad in front, narrowing behind, mesosternal portion broadly and deeply sulcate (Fig. 4) whereas in *H. picicornis* the carina is narrower and has a much weaker groove (Fig. 5). Apical portion of sternal carina tending to bend upwards so as to remain equidistant from abdomen whereas in *H. picicornis* it is almost invariably straight or bent downwards away from the abdomen. The tips of the parameres are more swollen in this species.

Types

Stethoxus loriai Regimbart. Holotype male labelled 'L.Loria/Muso Civ Genova' with handwritten label 'loriai Reg' in MNHP. I herein desig-



FIGURES 6–16. Protarsus of male: 6, *H. viridis*; 7, *H. infrequens*; 8, *H. albipes*; 9, *H. picicornis*; 10, *H. brevispina*; 11, *H. australis*; 12, *H. loriae*; 13, *H. pedipalpus*; 14, *H. novaeguinea*; 15, ditto *H. latipalpus*; 16, *H. macronyz*.

nate it lectotype since it is unclear whether this is a holotype or a syntype.

Hydrous gebieni Knisch. Not located (not in BMNH, MNHP, or Brussels). Synonymy based on examination of type and description of *H. gebieni*.

Distribution

New Guinea; L. Loria, Amboin (ANIC), Lae and Humboldt Bay District, Irian Jaya (in BMNH), Kaiserin Augusta River (type locality of *H. gebieni*). The four specimens from Amboin, New

Guinea, (Col. H. Ohlmus 16/10/74) agree well with the type except that they are noticeably broader.

Remarks

The differences between *H. loriai* and *H. picicornis* are slight and at first I considered the former only a subspecies of *H. picicornis*. However the three Amboin specimens were collected together with typical *H. picicornis* which virtually rules out subspecies. This and the lack of specimens with intermediate characters, particularly the broadly sulcate sternal carina, have persuaded me to treat *H. loriai* as a good species.

Hydrophilus australis Montrouzier

Hydrophilus australis Montrouzier, 1860, p. 248; Fauvel, 1883, p. 351. *Stethoxus australis* (Montrouzier), Fauvel, 1903, p. 351; Bedel, 1891, p. 317; Kuwert, 1893, p. 87; Regimbart. 1902, p. 207. *Hydrous australis* (Montrouzier), Knisch, 1924, p. 247.

Description (number examined 26)

Length 32–36 mm. Oval, dark olive-green to black. Appendages of head, a well marked spot at sides of each abdominal segment, the membraneous hind edge of abdominal segments 2–4 and hind portion of emarginate area on clypeus reddish-yellow. Head with clypeus deeply and widely emarginate, 40–60 large punctures on frons area, densely covered with extremely small punctures with scattered larger ones. Pronotum punctured as on head, with a distinct groove around lateral edge, except for hind angle, and along front margin to about ½ way to centre, some large punctures towards sides. Elytron punctured as on head with a minute reticulation, four longitudinal rows of rather sparse scattered large punctures, each row flanked on either side by a row of small punctures, towards apex these become more noticeable than main rows of punctures, towards front virtually untraceable. Apex of elytron rounded, with well-marked small spine. Sternal carina quite broad particularly towards front where it is deeply and widely grooved, weakly but sharply grooved towards rear, spine sharp, reaching to or just beyond base of 2nd abdominal segment. Posternal pillar pointed, deeply grooved for receiving end of sternal carina. Lateral plate of mesosternum relatively long and narrow. Metatibia relatively narrow, equal to or a little less than width of second abdominal segment. Metacoxal plate narrow, a little narrower than metatibia. Pilose portion of 1st abdominal segment reduced to narrow band along front margin, that on other abdominal segments about ¼ width of segments, both virtually lacking in setae. Abdominal segments 2–5 with broad, rather ill-defined roofing, groove around edge of apical abdominal segment lacking in apical ¼.

Female: protarsi not expanded [segment $5<(2>3>=4<1)$ in length].

Male: protarsi as in Fig. 11. Claws thin, curved, subequal [segment $5<(2>3=4<1)$ in length]. Parameres flat, aedeagus relatively short, opening of spermathecal duct beyond middle.

Type

A specimen of unknown sex, labelled 'Hydrophilus Australis Montr, N. Caledonie' in MNHP from Coll. L. Bedel, 1922. The specimen lacks palps and protarsi. Since it is unclear whether this is a holotype or syntype I herein designate it as lectotype.

Distribution

New Caledonia.

Remarks

Separated from the other large *Hydrophilus* of the region by having the tips of the elytra distinctly spined and the spine of the sternal carina reaching at least to the second abdominal segment.

Hydrophilus brevispina Fairmaire

Hydrophilus brevispina Fairmaire, 1879, p. 80; Fauvel, 1883, p. 351. *Stethoxus brevispina* (Fairmaire), Bedel, 1891, p. 317; Regimbart, 1902, p. 208. *Hydrous brevissimus* Kuwert, 1893, p. 87, either a mistake or unjustified emendation of *Hydrous brevispina* Fairmaire, 1879; Blackburn, 1896, p. 225. *Hydrous brevispina* (Fairmaire), Knisch, 1924, p. 247. *Hydrophilus scissipalpis* Blackburn, 1901, p. 128, syn. nov. *Hydrous scissipalpis* (Blackburn), Knisch, 1924, p. 257.

Description (number examined 219)

Length 27–35 mm. Elongate oval. Dark olive-green, appendages reddish, an orange-yellow patch in middle of each ventral abdominal segment at sides. Head with clypeus deeply and widely elongate, exposed portion yellowish, 60–80 large punctures in frons area, densely covered with much smaller punctures of two sizes, smallest very small but well-marked. Pronotum punctured on head, with distinct groove around lateral edge and for about ¼ way along front margin, some large punctures inwards of this groove in front angles. Elytron punctured as on head with four longitudinal rows of scattered punctures in weak depressions, flanked on either side by a row of extremely small punctures

only noticeable in some lights; apex of elytron bluntly rounded, not truncated. Sternal carina narrow, flat in front, weakly but sharply grooved in hind quarter, a short sharp ridge in midline at rear of mesosternal portion in some, spine short, blunt reaching to about ½ way across first abdominal sternite. Prosternal pillar thin, pointed, open with little or no hood over groove for sternal carina. Lateral plate of mesosternum relatively short and broad. Metatibia relatively broad, a little larger than width of 2nd abdominal segment. Pilose portion of 1st abdominal segment to about ⅓ width. Rugose portions of other abdominal segments reduced to small patches in front angles at sides about ⅓ width of segment. Abdominal segments weakly roofed in midline. Groove around edge of apical abdominal segment complete or only broken for short distance at apex. Metacoxal lobe narrow, narrower than width of metatibia.

Female: protarsi not expanded [segment 5 = (2 > 3 > 4 > 1) in length], claws subequal with large subbasal tooth.

Male: protarsi as in Fig. 10. Segment 5 expanded with membrane like flap on bottom front margin [segment 5 > > (1 = 2 = 3 = 4) in length]. Claws elongate, outer larger and thinner than inner. Second joint of maxillary palpi expanded slightly triangularly inwards near apex. Aedeagus thin, weakly expanded at tip. Parameres weakly hooked on outside of tip. Opening of spermathecal duct midway along aedeagus.

Types

Hydrophilus brevispina Fairmaire. Not located. Type locality, Brisbane.

Hydrophilus scissipalpis Blackburn, Holotype, '6971 Central Australia'. BMNH. Synonym based on description and examination of type.

Distribution (Fig. 17)

Widespread throughout Australia except for the south-east and Tasmania and possibly also the south-west.

H. brevispina is often confused with *H. albipes* but is readily separated from that species by its much more robust metafemora as well as characters given in the key. Both species are relatively common and are widely sympatric. However *H. brevispina* occurs much further north than *H. albipes*. *H. albipes* is common in south-eastern Australia, Tasmania and the south-west where *H. brevispina* is absent.

Remarks

H. brevispina is moderate-sized, stout, dark olive-green species readily recognized by the complete groove on the apical abdominal segment, small amount of pilosity on abdominal segments, stout metafemur, narrow posternal pillar and relatively large marginal groove along front edge of pronotum.

Additional Localities

VIC. — Ouyen ANIC, Wyperfeld ANIC, 73 km W N.S.W. — Armidale ANIC, 32 km SSW Bourke SAMA, Byrock ANIC, Deniliquin NMV, Dubbo NMV, Glen Innes AM, Grafton ANIC, Milparinka SAMA , Mitchell AM, Mootwingee ANIC NMV, Moree AM, Mt Hope ANIC, Paroo R. BMNH, Parkes AM, Singleton ANIC, Tamworth ANIC, Tibooburra ANIC, Tooraweenah ANIC, Trangie ANIC, Wanaaring ANIC, Willandra Bridge ANIC, Wyvern Bringagee AM. QLD. — Alexandria Stn AM, 49 km SW Arrilalah ANIC, Ayr QDPI, Bedourie ANIC, 138 km NW Bedourie AM, Biggenden ANIC, Bowen SAMA, Burnett R. ANIC, Calliope R. ANIC, Camooweal ANIC, Chillagoe ANIC, Coopers Creek BMNH, Cunnamulla ANIC AM SAMA, Durham Downs ANIC, Eidsvold AM, Emerald ANIC, Funnel Ck ANIC, Glenormiston ANIC, Goondiwindi ANIC, 48 km ESE Hungerford ANIC, 35 km SE Ilfracombe ANIC, Lake Dynevor ANIC, Lawn Hill ANIC, Longreach ANIC, Mackay AM, Mareeba QDPI, Mitchell SAMA, Mt Spec ANIC, Noccundra ANIC, Nockatunga ANIC, Normanton SAMA, Rockhampton ANIC SAMA, 40 mile Scrub ANIC, Silver Plains ANIC, Somerset Dam ANIC, Tanbar ANIC, Taroom ANIC, Thylungra ANIC, 10 km E Tjabulka AM, Townsville ANIC BMNH QDPI, 90 m S Urandangie ANIC, Warwick AM, Wilson R. ANIC, Yeppoon ANIC (BMNH). S.A. — Anna Ck Stn SAMA, 26 km NW Alberga RS SAMA, Blinman SAMA, Cadelga O.S. SAMA, Callabonna SAMA, Cameron Corner SAMA, Coward Spr. 40 km E Frome Downs SAMA, Hay R. Simpson Desert SAMA, Iron Duke SAMA, Kalamurina Stn SAMA, Lake George ANIC, Mabel Ck Stn SAMA, 28 km SSW Mabel Ck Stn SAMA, Marree SAMA, Mt Serle SAMA, Oodnadatta NMV SAMA, Strathearn HS SAMA, Stuart Ck Stn SAMA. N.T. — Alexandria BMNH, Alice Springs SAMA NTM, 1 km N Barrow Ck NTM, Borroloola ANIC, Glenormiston Stn SAMA, Hermannsburg BMNH, Kings Canyon NTM, McArthur R. ANIC, 19 km SW Mt Cahill ANIC, Simpson Gap NTM SAMA, 41° S 133° 25′E NTM, 24° 05′S 134° 00′E NTM, Yuendumu ANIC. W.A. — Ashburton R. WAM, Barradale ANIC, Cane River HS ANIC, Cape Bertholet ANIC, Carnarvon-Exmouth Rd BMNH, Kununurra ANIC, Minilya R. ANIC, Prairie Down Stn SAMA, Wuranga ANIC.

Hydrophilus albipes Castelnau

Hydrophilus albipes Castelnau, 1840, p. 51. *Sethoxus albipes* (Castelnau), Bedel, 1891, p. 317; Regimbart, 1902, p. 207. *Hydrophilus albipes* Castelnau, Blackburn, 1896, p. 255. *Hydrous albipes* (Castelnau), Kuwert, 1893, p. 87; Knisch, 1924, p. 245.

Description (number examined 487)

Length 20–31 mm. Narrowly oval. Black, appendages reddish, diffuse reddish patches at sides of abdominal segments. Head with clypeus quite deeply and widely emarginate, exposed portion yellow only in hind half, 60–80 large punctures on frons, densely covered with small but well-marked punctures of two main sizes, the large less numerous than the smaller. Pronotum punctured as on head, with distinct groove around lateral sides and a short distance along front margin; some large punctures inward of this groove in front angles. Elytral punctures as on head, with four longitudinal rows of scattered punctures, flanked on either side by a row of extremely small punctures only visible anteriorly in certain lights but well-marked at apex. Apex of elytron rounded, with very small spine in extreme apex. Sternal carina thin, a little broader in area of mesosternum, flat except for weak sharp groove towards rear, spine short blunt reaching to about ⅓ width of first abdominal segment. Prosternal pillar broad, bluntly pointed, groove for sternal carina reaching only about ½ depth of pillar. Lateral plate of mesosternum relatively narrow. Metatibia relatively narrow, a little narrower than 2nd abdominal segment. Rugose portion of first abdominal segment covering all but narrow area along hind edge, hind angles and midline of segment, lateral portions on other abdominal segments about ⅓ width of segment. Anterior abdominal segment quite strongly roofed in midline. Groove around edge of apical abdominal segment lacking in apical ¼. Coxal lobe narrow, narrower than metatibia.

Female: protarsi not expanded [segment 5< (2>3>4>1) in length], claws with a large basal tooth.

Male: protarsi as in Fig. 8 [segment 5 expanded, particularly on bottom front margin [segment 5<(2=3>4>1) in length]. Claws stout, inner a bit stouter and a little shorter than outer. Palpi normal. Aedeagus and paramere long and thin. Opening of spermathecal duct ⅓ way along aedeagus.

Type

Hydrophilus albipes Castelnau. Not located. Type locality given as New Holland.

Distribution (Fig. 17)

A widespread southern species.

Remarks

H. albipes is a small, narrow, black species separated from other *Hydrophilus* by its small size, short sternal carina, incomplete groove around edge of apical abdominal segment, slim metafemur, and with row of setae on outer face of protibia only about ½ length of tibia.

Additional Localities

N.S.W. — Balranald ANIC, Bathurst AM, Binnaway AM, Broken Hill SAMA, Canberra ANIC, Corowa ANIC, Deniliquin ANIC, Girilambone ANIC, Gundaroo ANIC, Hay ANIC, Louth AM, Marrabui BMNH, 24 km ENE Broken Hill AM, 5 m S Mendooran AM, Mitchell AM, Moree MM, Mt Moodie ANIC, Mudgee ANIC, Rylstone SAMA, Silverton ANIC, Singleton ANIC, Trangie ANIC, Uralla ANIC, Wagga Wagga ANIC, Willandra Bend ANIC, Yagobie ANIC, Yanco AM. VIC. — Benambra AM, Bendigo ANIC, Bundoo Rng. AM, Euroa NMV, Gelibrand NMV, Grampians ANIC AM, Halls Gap SAMA, Hattah lakes ANIC SAMA, Kerang AM, Kulkyne Forest ANIC, Lady Julia Percy I. AM, Little Desert ANIC, Melbourne BMNH, Frankston AM, Melbourne NMV BMNH SAMA, Moe ANIC, Moyston ANIC, Otways SAMA, Sealake ANIC, Terang ANIC, Warragul ANIC, Warranabool NMV, Wyperfield Nat. Pk ANIC, Yanac ANIC. S.A. — Adelaide BMNH SAMA, Beachport SAMA, 23 m NE Billa Kalina HS SAMA, Bool Lagoon SAMA, Coward Sp. SAMA, Etadunna WAM, Fairview Park Con. Res. SAMA, 40 km E Frome Downs SAMA, Frome R. Crossing SAMA, Kangaroo I. AM, Koonamore Stn SAMA, Lake Callabonna AM SAMA, Lake Eyre SAMA, Monarto SAMA, Mungerannie Stn SAMA, Mylor SAMA, Nangwarry SAMA, Naracoorte SAMA, Parachilna SAMA, Penola SAMA, Taratap Stn SAMA, Waitpinga SAMA, Whyalla NMV, Yunta SAMA. TAS. — Carlton ANIC, Hobart SAMA, Launceston NMV SAMA, Longford ANIC. W.A. — Albany WAM, Armadale WAM, Boxwood Hill ANIC, Bullsbrook WAM, Cape Arid ANIC, Cervantes ANIC, Claremont ANIC, Culcurdool WAM, Darling Rng. AM, Esperance ANIC, 63 km E Esperance ANIC, Forrestdale WAM, Geraldton ANIC, Guilderton ANIC, Helena R. WAM, Hopetown ANIC, Kalbarri Nat. Pk ANIC, Mt Arid ANIC, Point Peron WAM, Preston R. ANIC, Thomas R. ANIC, 10 m SW Three Springs SAMA, Wanneroo WAM, Wilga ANIC.

FIGURE 17. Distribution maps of Australian *Hydrophilus* species.

Hydrophilus infrequens sp. nov.

Description (number examined 3)

Length 24–25 mm. Oval. Upper surface, when dry, varying from dark with olive-green tinges to dark with reddish tinges, elytra with vague dark strips in serial puncture lines, at higher magnification elytra covered with thin black interdigitating lines more noticeable in greenish individuals. Ventral surface black, appendages of head and lateral patches on abdominal segments reddish. Head shallowly emarginate for about half width of frons, basal half of exposed portion yellowish, front portion black. About 60 large punctures lying in two V-shaped weak grooves on frons, which is densely covered with small but well-marked punctures predominantly of two sizes with the smaller more numerous. A well-separated pair of pits bearing long setae in middle of frons. Pronotum punctured as on head, with a distinct groove along lateral edges and along front edge for a very short distance, a few groups of 2 large punctures towards sides. Elytron with lightly impressed fine reticulation and scattered very small punctures of variable sizes, also four loose rows of large punctures flanked on each side by a row of punctures which are subobsolete towards front but as large as serial punctures at apex. Band of closely placed but scattered punctures along lateral edge of elytron. Apex of elytron rounded. Sternal carina, flat, broad, particularly mesosternal portion, constricted between mesocoxae and narrowing at both front and rear end, spine blunt reaching a little over ½ width of first abdominal segment. Prosternal pillar pointed, groove to receive sternal carina narrow about ½ width of pillar in depth. Lateral plate of mesosternum narrow, relatively long, metacoxal plate narrow, both narrower than width of metafemur which is about same width as second abdominal segment. Pilose area on underside covers all abdominal segments except for approximately the central half of segments 2–5.

Female: protarsi not expanded, protarsal claw with small spine on underside about middle [segment 5 < = (2 > 3 > 4 = 1) in length].

Male: protarsi as in Fig. 7. Segments a little thicker than in female and slightly expanded on front bottom edge. Claws simple, evenly curved along outer edge. Segment 5 = (2 > 3 = 4 = 1) in length. Parameres short, broad. Aedeagus with spermathecal duct opening near tip.

Types

Holotype: ♂ '28°52'S 153°03'E Casino, N.S.W, 12.XII.1971, Key and Balderson', 'at light' in ANIC. Paratypes: 1, ♂ 'Brisbane 1/30' 'J.G. Brooks Bequest 1976'; 1, ♂, '1 ml N of Brunswick Heads N.S.W. 1 Jan 1973 R.J. Kohout', in ANIC.

Distribution (Fig. 17)

Known only from the type localities on the east coast near the New South Wales/Queensland border.

Remarks

This and *H. viridus* are closely related and separated from other Australasian *Hydrophilus* by the extensive lateral pilosity on the abdominal segments and the presence of a pair of setae bearing pits or a tight group of large punctures on the front of the frons. *H. infrequens* is separated from *H. viridis* by its generally larger, darker and more rounded shape, stronger punctation on upper surfaces, slight difference in pilose area on underside, broader tip to the parameres, spermathecal duct opening at end of adeagus rather than further down, and slightly more robust male protarsi.

Hydrophilus viridis sp. nov.

Description (number examined 4)

Length 18–21 mm. Elongate oval. Olive-green, extreme edges of elytron, pronotum and scutellum black, two small black spots at rear of pronotum. Underside black, legs reddish, appendages on head yellow-brown. Head deeply but rather narrowly emarginated, basal half of exposed portion yellow-brown, front portion black, 70–90 large punctures lying in two V-shaped weak grooves on frons, a well-separated pair of small pits in middle of frons with large setae emerging from them, densely covered with small but well-marked punctures of varying sizes. Pronotum punctured as on head, with distinct groove around lateral edge and along front edge for a short distance, a few groups of large punctures towards sides. Elytron with fine reticulation and scattered minute punctures, also four loose rows of large punctures flanked on each side by a row of very small punctures more distinct towards apex. Apex of elytron rounded. Sternal carina wide, constricted between mesocoxae and narrowing at both front and rear, spine blunt, reaching to beginning of second abdominal segment. Prosternal pillar pointed, narrowly but not deeply grooved for reception of sternal carina. Lateral plate of mesosternum narrow, relatively long, metacoxal plate narrow, both narrower than metafemur which is about width of 2nd abdominal segment. Pilose area of underside covers all abdominal segments except for central ½ of segments 2–5.

Male: protarsi as in Fig. 6. Segments not expanded, claws simple, sharply bent near base [segment 5 > = (2 > 3 = 4 = 1) in length]. Parameres short, broad. Aedeagus with spermathecal duct opening around middle.

Distribution (Fig. 17)

Known only from the type localities in coastal northern Queensland.

Types

Holotype: ♂ '14m. S. Coen.N.Q. 780' 18.5.72. J.G. Brooks' 'At light' 'B 73 of 82' in ANIC. Paratypes: 1, ♂ 'Ingham Qld 24.2.1960 K.L. Harley' in ANIC; 1, ♂ 'Townsville Qld. 19.4.63 C.W'. in CW; 1, ♀ 'Atherton 14.XII.58. G. Ettershank' in QM.

Remarks

A rare species with a pronounced olive-green colour when dry. Separated from the closely related *H. infrequens* by characters given under that species.

Hydrophilus novaeguineae sp. nov.

Description (number examined 6)

Length 32–43 mm. Elongate oval. Black, appendages of head and small round patches at sides of abdominal segments dark-reddish. Head with clypeus deeply emarginate for about half width of clypeus, exposed portion dark reddish in front half, 60–80 large punctures on frons in addition to a dense patch inwards from each eye, moderately densely covered by small but variably-sized punctures. Pronotum punctured as on head, with a distinct groove around lateral edge and a short distance along front edge, scattered large punctures towards sides. Elytron punctured as on head with four longitudinal rows of scattered well-impressed setae-bearing punctures each flanked by a row of very small punctures, virtually untraceable towards front, and a single line of close punctures adjacent to lateral edge. Apex of elytron rounded without spine. Sternal carina slightly swollen, sharply but weakly grooved in final section, widely but very shallowly grooved in front section, hind portion of front section with distinct midline carina, hind end of front section slightly above front end of rear section; spine blunt and short, reaching a little more than halfway across first abdominal segment. Prosternal pillar sharply pointed only shallowly grooved to take sternal carina. Lateral plate of mesosternum short, relatively broad. Metatibia stout, noticeably wider than 2nd abdominal segment, metacoxal plate narrower than metafemur. Pilose portion of 1st abdominal segment covering about ⅓ of width of segment, that on sides of other segments about ⅓ of width of segments. Abdominal segments 1–4 weakly roofed in midline. Groove around edge of apical abdominal segment absent in apical portion.

Female: protarsi, segment 5 > >(2=3=4>1) in length, claw with strongly developed spine underneath in about middle. Front section of sternal carina flat. Groove on prosternal pillar deeper than in male. Labial palpi stout.

Male: protarsi as in Fig. 14, segments 1–4 same length, short, progressively more expanded, segment 5 twice length of other segments combined and with thin projection along front edge about half width of rest of segment [segment 5 > >(1=2=3=4) in length]. Claws considerably enlarged, outer about ⅓ again length of inner. Maxillary palpi with apex of second segment weakly expanded and flat, labial palpi expanded, much stouter than in female. Genitalia broad, tip of paramere curved, terminating in small sharp spines, aedeagus relatively thick and short, spermathecal duct opening a little below tip.

Types

Holotype: ♂ 'Papua 9 ml. NE. by N. of Port Moresby. 9°22′S 147°13′E. 23 viii. 1970, Key and Balderson. (Key's field notes; Trip 167. stop 21050.8). At light', in ANIC. Paratypes: 2, ♀ 'New Guinea, Port Moresby (Mt. Lawes, 1300 ft.), 5.3–12.5.1963. W.W. Brandt.' in ANIC.

Distribution

New Guinea; known only from the type localities and Amboin (in ANIC and CW).

Remarks

The large size, relatively short, broad male genitalia with hooked tips to parameres, robust metafemur, and small amount of pilosity on first abdominal segment, ally *H. novaeguineae* to *H. macronyx*. It is separated from that species by the much less elaborate male protarsi, thickened labial palpi and the spine on the underside of the protarsal claws in the female being towards the middle of the claw rather than at the base.

Hydrophilus pedipalpus (Bedel 1891) comb. nov.

Stethoxus pedipalpus Bedel, 1891, p. 317; Kuwert, 1893, p. 87; Regimbart, 1902, p. 210. *Hydrous pedipalpus* (Bedel), Knisch, 1924, p. 250.

Description (number examined 72)

Length 35–46 mm. Elongate oval. Black, appendages of head, and round patches at sides of abdominal segments dark-reddish. Head with clypeus deeply emarginate but for a relatively short distance (deepest point ½ width of clypeus). Exposed portion dark reddish in hind half, 60–80 large punctures on frons, densely covered with very small but variably sized punctures. Pronotum punctured as on head, with a distinct groove around lateral

edge, except hind ⅛th, virtually absent from front margin, with scattered large punctures towards sides. Elytron punctured as on head with four longitudinal rows of scattered weakly-impressed large punctures, these are flanked on each side by a row of very small punctures, distinct towards extreme apex but over much of elytron virtually lacking and only visible in certain lights, not lying in grooves except extremely weak ones at extreme apex. Apex of elytron weakly truncated with small blunt spine. Sternal carina swollen, constricted between mesocoxae, weakly grooved in hind portion, broadly and quite deeply grooved in front portion. Spine short, blunt, reaching to about halfway across 1st abdominal segment. Posternal pillar sharply pointed, groove for reception of sternal carina relatively shallow, reaching less than halfway into pillar on top edge. Lateral plate of mesosternum short, relatively broad. Metafemur quite broad, a little wider than 2nd abdominal segment. Metocoxal plate narrow, narrower than metafemur. Pilose portion of 1st abdominal segment covering well over ½ width that segment, that on sides of other abdominal segments about ⅓ width of segment. Abdominal segments 1–4 roofed in midline. Groove around edge of apical abdominal segment lacking in apical ¼–⅓.

Female: protarsi not expanded [segment 5 < < (2 > 3 > 4 > 1) in length]. Front portion of sternal groove flat, groove on prosternal pillar deeper than in male.

Male: protarsi as in Fig. 13. Segments 5 and 4 and portion of 3 enlarged, particularly on outer bottom edge [segment 5 < < (2 = 3 = 4 > 1 in length], claws elongate, strongly curved at base, subequal in length, inner stouter than outer. Maxillary palpi with first segment expanded particularly in apical ½ where it is deeply excavated below, apical segment short and stout. Labial palpi with first segment expanded. Genitalia with paramere tips broad and flat, aedeagus relatively thick, spermathecal duct opening below middle.

Type

A male labelled 'Australia E. Deipolle/Pedipalpus Bed', in MNHP. Since it is unclear whether this is a holotype or syntype, I hereby designate it lectotype.

Distribution (Fig. 21)

Coastal eastern Australia from Victoria northwards. A more northern species than the quite similar *H. latipalpus*. These species occur sympatrically on the south coast of New South Wales. *H. pedipalpus* differs from *H. latipalpus* by the weaker development of elytral striae, by the flat anterior portion of the sternal keel in both sexes and the strongly expanded maxillary and labial palps in the male.

Additional Localities

QLD. — Atherton, Biggenden ANIC, Brisbane AM, Edungalba ANIC, Julatten AM, Proserpine ANIC WAM, Rockhampton BMNH, Surfers Paradise ANIC QDPI, Yeppoon ANIC. N.S.W. — Alstonville AM, Armidale ANIC, Casino ANIC, Cessnock AM, Clarence R. BMNH, Evans Head ANIC, Fairfield BMNH, Kempsey SAMA, Macleay R. ANIC, Maitland ANIC, Pt Macquarie AM, Roseville AM, Tamarong AM, Terrigal ANIC, Tyndock AM, Wang Wauk AM, Wauchope AM.

Hydrophilus latipalpus Castelnau

Hydrophilus latipalpus Castelnau, 1840, p. 51. *Stethoxus latipalpus* (Castelnau), Bedel, 1891, p. 317; Regimbart, 1902, p. 209. *Hydrous latipalpus* (Castelnau), Kuwert, 1893, p. 87; Knisch, 1924, p. 249.

Description (number examined 121)

Length 30–41 mm. Oval. Black, patches at sides of abdominal segments and appendages of head lighter. Head with clypeus deeply emarginate, 100–120 large punctures in frons area, densely covered with small punctures of two sizes, the smaller sizes predominating. Pronotum punctured as on head, with a distinct groove around lateral edge except hind ⅛, and for a short distance along front margin, with numerous large punctures inwards of groove in front angles. Elytron punctured as on head with four longitudinal rows of scattered large punctures, these are flanked on each side by well marked rows of scattered small punctures which, except on disc, and particularly towards apex, lie in shallow grooves. Apex of elytron bluntly rounded. Sternal carina thin, flat except for well-marked groove in midline toward rear, spine short, sharply pointed, reaching to about base of 2nd abdominal segment. Prosternal pillar sharply pointed, groove for sternal carina deep. Lateral plate of mesosternum short, relatively broad. Metatibia quite broad, about as wide as 2nd abdominal segment. Metacoxal plate narrow, narrower than metatibia. Pilose portion of 1st abdominal segment covering a bit more than half of segment, that on sides of other abdominal segments reaching a little under half way across segment. Abdominal segments 1–4 quite strongly ridged in midline. Groove around edge of apical abdominal segment lacking from apical ⅓.

Female: protarsi not expanded [segment 5 < - (2 > 3 > = 4 > 1) in length], claws elongate each with a basal tooth. Front edge of sternal carina projecting downwards to a variable degree.

Male: protarsi as in Fig. 15, moderately expanded, claws subequal, bent, flattened with small expanded lobe at base [segment 5 < < (2 > 3 = 4 = 1) in length]. Maxillary palpi with apical half of second

segment greatly expanded, hollow beneath, apical segment a little expanded below apex.

Type

Not located. Type locality given as New-Holland.

Distribution (Fig. 17)

South-eastern and south-western Australia and Tasmania.

Remarks

The commonest of the large *Hydrophilus* in Australia, readily separated from *H. pedipalpus* (and *H. australis* from New Caledonia) by the downward lump at the front of the sternal carina in the female, and the moderately expanded male maxillary palpi and by the stronger development of the elytral striae.

Additional Localities

N.S.W. — Araluen ANIC, Leeton AM, Paroo R. BMNH, Nowra BMNH, Strathfield AM, Sydney AM. VIC. — ANIC, Dimboola SAMA, Grampians SAMA, Hattah Lakes ANIC, Hazelwood ANIC, Latrobe Valley NMV, Little Desert ANIC, Melbourne BMNH, Morwell NMV, Otway Ra. SAMA, Ouyen ANIC, Strathfield NMV, Stawell NMV, Swan Hill ANIC, Wyperfield Nat. Pk ANIC. S.A. — Adelaide SAMA, Bool Lagoon SAMA, Cape Jaffa SAMA, Coorong SAMA, Furner SAMA, Glencoe SAMA, Kingscote (K.I.) AM, Kingston SAMA, Mt Scott SAMA, Naracoorte AM, Penola SAMA, Taratap Stn SAMA. W.A. — Midland WAM, Morgers Lake WAM, Mt Arid ANIC, Perth WAM, Swan R. SAMA, Wilga ANIC. TAS. — Freycinet Nat. Pk ANIC, Launceston SAMA, Longford ANIC, Swansea ANIC, Tasmania SAMA.

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DIAMONDS FROM THE ECHUNGA GOLDFIELD, SOUTH AUSTRALIA

F.L. GOMMERS

GOMMERS, F.L. 1988. Diamonds from the Echunga Goldfield, South Australia. *Rec. S. Aust. Mus.* 22(2): 131-138.

Small gem quality diamond crystals have been found by miners working the alluvial gold deposits on the Old Echunga Diggings west of Chapmans Gully near Echunga, 30 km south-east of Adelaide. The first diamonds were recovered in 1859, and in the next fifty years at least 20 and perhaps as many as 50 more were found. The largest stone weighed 5 5/16 ct. Only five of the diamonds found at Echunga last century can be traced; three are in the collection of the South Australian Museum, and two in the collection of the South Australian Department of Mines and Energy. This paper traces the history of the diamond occurrence and establishes the authenticity of stones in the Museum collection.

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The South Australian Museum collection contains three diamonds which are purported to have come from the Echunga Goldfield, 30 km south-east of Adelaide (Fig. 1). These specimens are amongst the most frequently examined and studied specimens in the Museum's mineral collection. However, there has long been uncertainty and scepticism over authenticity of the locality data for these stones. The diamonds were reputed to occur with alluvial gold, but no kimberlitic source or indicator minerals were found by early investigators.

Geological units in the Goldfield comprise Holocene and Tertiary sediments, predominantly ferruginous alluvial gravel and sand, unconformally overlying kaolinised slate and schist of Torrensian age. The alluvial gold is thought to have been derived from quartz reefs in the older rocks (Ludbrook 1980).

Background

The discovery of gold in Victoria in 1851 and the ensuing rush to the fields from all parts of Australia prompted the government in South Australia to offer a reward of £1 000 for the discovery of payable gold in the colony.

W. Chapman Snr, R. Hardiman and H. Hampton were first to claim the reward for the discovery of gold, near Echunga in the Mount Lofty Ranges. They were eventually paid £500 by the Government. In 1852 Chapman's son William, who had recently returned from the Victorian goldfields, found alluvial gold near Warland's Wheatsheaf Inn, now known as 'Warrakilla', on the Onkaparinga River. William Chapman and his father traced the gold back to its source in a gully, later to become known as Chapman's Gully (Whimpress 1975). The initial rush here lasted only a few months but, at its height, 600 people were living on the diggings and about 5 000 oz. of gold were found. From 1853 to 1868, further discoveries were made in an area west of Chapman's Gully, notably at Long Gully, Christmas Rush and Poor Man's Hill, and further afield at Donkey Gully and Hahndorf Gully.

In 1868, Thomas Plane and Henry Saunders found a rich field at Jupiter Creek, 3 km south of Chapman's Gully; they received £300 and £200, respectively, from the South Australian Government in reward for their discovery. Jupiter Creek was worked in several phases between 1868 and 1907. Up to 1 500 diggers were working the field at the height of the rush between 1868 and 1871.

The Echunga Goldfield now covered three areas, the Old Echunga diggings (including Chapmans Gully), Jupiter Creek, and the Hahndorf to Mylor area which included Donkey Gully and Biggs Flat (Fig. 1). By 1900, about 400 000 oz. of gold had been recovered and the area had become the state's most productive field. Drew (1984) gives a more complete outline of the geology and history of the workings.

Miners working the Echunga alluvials occasionally found small gem quality diamonds in their pans and cradles. Over the fifty-year period in which the goldfield was active, approximately 50 diamonds were reported to have been recovered (Brown 1908). These appear to have come mainly from the older part of the Echunga diggings west of Chapmans Gully, the principal localities being 'Long Gully', 'International Dam', 'Poor Man's Hill', 'Christmas Rush'and 'New Rush Hill'.

Doubts have been expressed about the occurrence and even the authenticity of these stones.

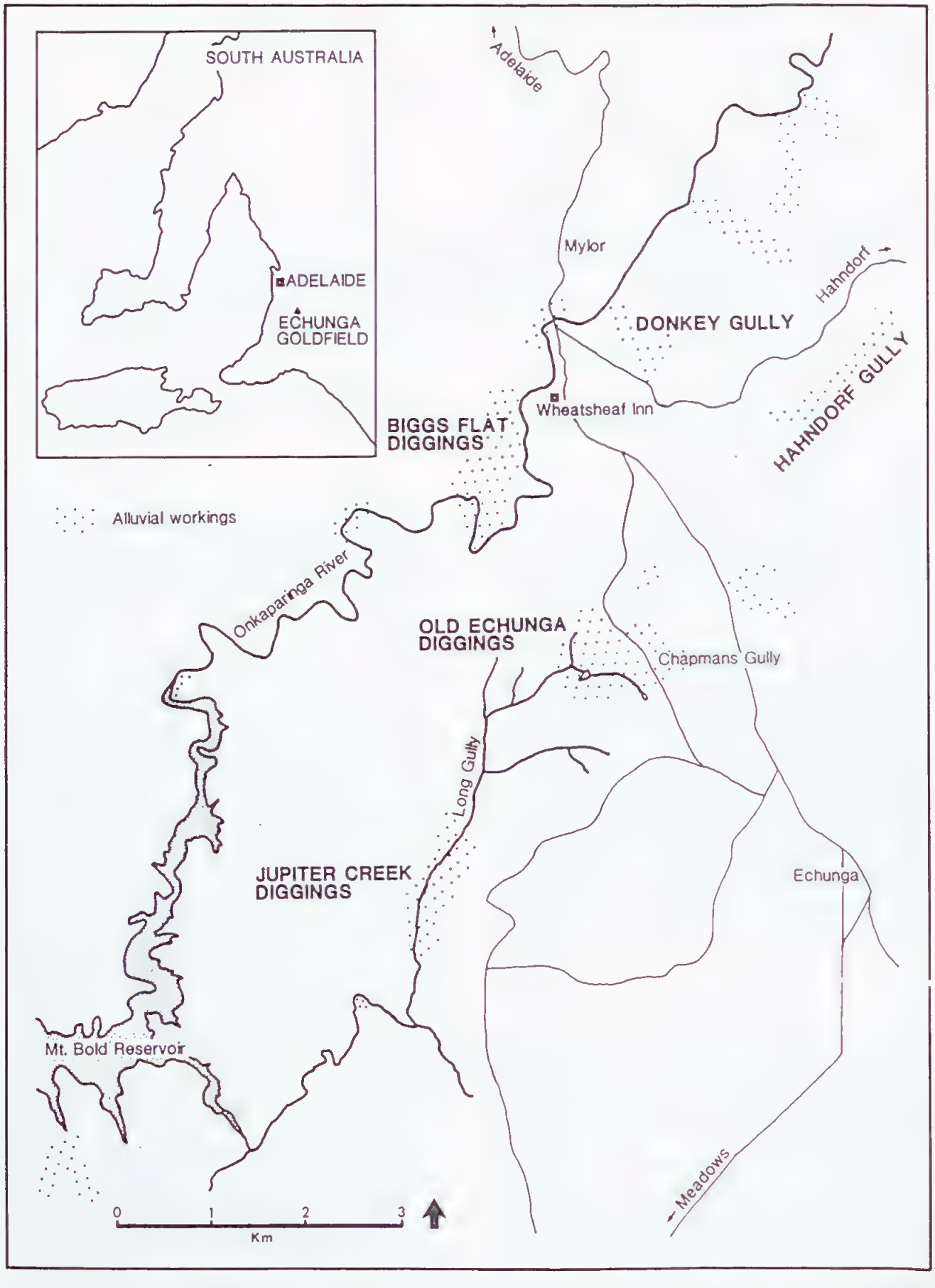


FIGURE 1. Map showing main areas of the Echunga goldfields. Diamonds were found on the Old Echunga Diggings west of Chapmans Gully.

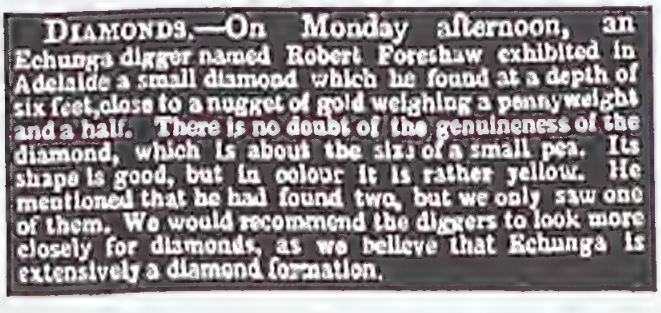
Suggestions were made that diggers returning from the South African fields had been 'salting' the area with diamonds, or that the stones were Brazilian or Indian (Duffield 1909). It is highly unlikely that the stones are South African, however, as the Kimberley field was not discovered until 1866, seven years after the first diamonds were recovered at Echunga.

History of the Diamond Finds

First discoveries

Uncertainty exists as to when and by whom the first diamond was found. The *Adelaide Observer*, a newspaper of the day, reported that Robert Foreshaw found a diamond near Echunga in March 1859 (Fig. 2). The yellow coloured stone was said to be about the size of a small pea, and was found at a depth of 2 m next to a small gold nugget. This seems to be the earliest recorded find.

Tom Hall and his brother Robert also claimed to have found the first diamond, at New Rush Hill. This stone was sold to Mr. E.R. Simpson of the South Australian Company (Hales 1909). No date for this find was given, however.



DIAMONDS.—On Monday afternoon, an Echunga digger named Robert Foreshaw exhibited in Adelaide a small diamond which he found at a depth of six feet close to a nugget of gold weighing a pennyweight and a half. There is no doubt of the genuineness of the diamond, which is about the size of a small pea. Its shape is good, but in colour it is rather yellow. He mentioned that he had found two, but we only saw one of them. We would recommend the diggers to look more closely for diamonds, as we believe that Echunga is extensively a diamond formation.

FIGURE 2. Report of first diamond find at Echunga from *The Observer*, 26 March 1859.

The *Adelaide Observer* of 21 January 1860 reported:

> A digger named William Hall who had been at work at the new diggings at Echunga, has brought down three supposed diamonds, which he recently discovered there while searching for gold. One is of large dimensions and weighs about an ounce; and the other two are about the size of peas. (*Adelaide Observer*, 21 Jan. 1860).

It seems highly unlikely that the one ounce stone was a diamond, as diamonds of this size (over 140 ct) are extremely rare and valuable. Had a 140 ct diamond been recovered then more extensive reporting of such a find would have been expected; the stone was more probably clear quartz.

By December of 1860, Mr Simpson had purchased 11 diamonds from miners at Echunga; two or three of these were said to be very pure in colour and the size of large peas (*Adelaide Observer*, 15 December 1860). In 1864, Mr Simpson offered two diamonds to the South Australian Institute for £12, which he said were '. . . if not the first found, which I believe, they are by far the most perfect of any yet discovered'. These may have been purchased by the South Australian Government and could be the stones mentioned in Brown (1908) as having been purchased by the Museum authorities. These are not, however, the two uncut stones currently held in the Museum collection.

Largest stone

The largest authenticated diamond found on the field appears to be the 5 5/16 (5 1/2?) ct stone discovered by a digger, John Glover, in August 1877 at Long Gully (Warden of Goldfields, 10 August 1877). Hales (1909) gives the weight as about 14 grains (4.5 ct) and places the find at Poor Man's Hill, but this account was compiled from reminiscences in 1909 and the weight conflicts with catalogue entries. Brown (1908) reports a 9 1/4 ct stone but no other mention of this gem was made in early records; the weight is probably a misprint of carats for grains, with the true weight being about 3 ct.

'Rennells Vision' diamond, found at Poor Man's Hill, was valued at £90 in the rough. Rennells, a prospector, known as the miner's prophet '. . . dreamt that he saw an angel pointing to the spot at the foot of Poor Man's Hill and heard a voice telling him to dig' (The *Advertiser*, 16 June 1909). His mate, not believing him, threatened to throw Rennells into the dam if he did not continue with their usual gold prospecting. A struggle took place near the edge of the water, but the ground gave way and his mate fell in, putting an end to his objections. Rennells continued searching and soon found his diamond. Unfortunately, the weight of this stone was not recorded.

A diamond weighing 3 1/2 ct was found in Long Gully by John Brown while gold washing in December 1867 (Warden of Goldfields, 8 December 1867).

The Dodd and Bean Reports

In the late 1870s, the diamond occurrence at Echunga was of considerable interest, with newspapers urging miners to be on the lookout for these gems and giving regular accounts of new finds. In 1878 and 1879, the Government commissioned two reports[1] on the diamond occurrence.

At the Paris Universal International Exhibition in 1878, two rough diamonds found by gold diggers John Brown and John Glover were exhibited in the South Australian Court (Fig. 3). Mr Boothby, Special Executive Commissioner for the South Australian Court, thinking the occurrence of diamonds in South Australia might be of great importance, submitted the gems to an expert, Mr Arthur Dodd of P.G. Dodd & Sons, diamond merchants, London, for an appraisal. The gems, of 5 5/16 ct and 3 1/2 ct, were cut on Dodd's recommendation. His report expressed the opinion that:

> A diamond field must exist near where these diamonds were found, for two reasons — First that the elevation of Echunga is about the highest point in the range of mountains forming a backbone of the country, therefore these stones could not have been washed down to that place; and secondly, by the evidence of the stones themselves showing no signs of travelling by worn surfaces or broken points. I am therefore of the opinion that the diggers for gold, who for years past have worked and washed the ground in this place, have passed unheaded hundreds of diamonds, not knowing them for worthless crystals or other stones of no value.

His report concluded:

> We do not suppose that Echunga is another South Africa, but at all events there is every reason to believe that the district is rich in diamonds, and it will pay a few enterprising men to give it a trial. If anything like success is attained there will of course be a rush. In that case the Government will have to make some arrangements for the proper regulation of claims, and companies no doubt will be organized to carry on a systematic search for the beautiful crystals (*Southern Argus*, 24 July 1879).

Following recommendations of the Dodd report, the Commissioner of Crown Lands in 1879 appointed Mr G.T. Bean, an experienced gem digger, to examine the potential of the Echunga Goldfield for diamonds and to recommend a course of action for their recovery. Bean reported that the field was similar to those in South Africa and recommended that a systematic search be made. He suggested that four or five men led by an experienced diamond digger should search the area. Bean also recommended that claims be 50 feet by 30 feet, with every digger entitled to two claims. The discoverer of a new find would be entitled to select five claims, and a company able to hold a block of up to 10 claims. He concluded that the best method was to wash all soil and gravel in a cradle and screen, and sort the screenings on a table. Bean nominated Mr A. von Doussa of Hahndorf, a diamond digger from Kimberley in South Africa, as leader of the search party (*Adelaide Observer*, 23 August 1879).

When the report was published others offered their services. One such offer was 'a gentleman . . . who was willing to organise a party and make a search for two or three months for a payment of £5 per week, which would not be claimed if their efforts were successful' (*Adelaide Observer*, 23 August 1879).

In 1880, to further help gold diggers on the fields to recognise diamonds, a collection of 11 rough Brazilian diamonds was displayed at the South Australian Institute, the forerunner of the South Australian Museum. These were obtained through Mr J. Boothby in London at a cost of £20. Unfortunately, they were stolen from the Museum in December 1881.[2]

Few additional diamonds appear to have to have been found after 1880; the only known report was of a diamond obtained by Mr Bertram of Echunga in 1886 (*The South Australian Register*, 22 May 1886).

The recommendations of the Bean Report were raised in South Australian Parliament in August 1879 by Mr Bray (Member for East Adelaide). At this time the Commissioner of Crown Lands reported the matter under consideration (South Australia, Parliament, 1879) but no further action appears to have been taken by the Government and the matter was dropped.

It has not been possible to accurately establish the number of diamonds found on the field between 1859 and 1900. Brown (1908) estimated that 50 stones had been found but an extensive search of newspaper reports and reports by the Warden of Goldfields at Echunga gave definite reference to only about 20 stones (Table 1). Hales (1909) lists a number of miners as having found gems on the field but no details of the stones are given.

CLASS 39.—JEWELLERY AND PRECIOUS STONES.

Steiner, Henry; Jeweller; *Rundle Street, Adelaide.*
Collection of Gold and Silver Jewellery, consisting of Brooches, Earrings, Crosses, Necklaces, Lockets, &c.

Brown, John; Gold Digger; *Echunga, South Australia.*
Diamond, rough as found on the Echunga Gold Field.

Glover, John; Gold Digger; *Echunga, South Australia.*
Diamond, rough as found on the Echunga Gold Field.

FIGURE 3. Catalogue entry for Echunga diamonds exhibited at the Paris International Exhibition, 1878.

Recent exploration

Little interest was expressed this century in the Echunga diamond occurrence until the mining boom of the 1970s enticed several companies to explore the area. The most extensive studies were made by Kimberely Diamond Quest NL and Nickel & Mineral Search NL who contracted Pacific Exploration Consultants to process over 75 tonnes of tailings from the Old Echunga Diggings, but these revealed only one microdiamond. CRA Exploration Pty Ltd also undertook extensive geophysical exploration in the area and located several magnetic

TABLE 1. Records of diamond finds at Echunga.

NAME OF FINDER	LOCATION	DATE	DETAILS	REFERENCE
Robert Foreshaw	New Rush Hill	1859	2 — first found	*Adelaide Observer,* 26 March 1859
William Hall	Echunga	1860	3 — a 1 ounce stone (prob. quartz), 2 the size of peas	*Adelaide Observer,* 21 January 1860
E.R. Simpson, South Australian Company, Adelaide	Echunga	1860	11 diamonds purchased from miners in the last twelve months	*Adelaide Observer,* 15 December 1860
John Brown	Long Gully	1867	1 weighing 3½ cts (exhibited in Paris)	Mem. of Proc. by Warden of Goldfields, 8 December 1867
H. Heuzenroeder, Chemist, Rundle St, Adelaide	Echunga	Before 1869	Acquired 2 diamonds, 1½ and 1 cts (exhibited in Melbourne and Sydney). In South Australian Museum collection.	*Adelaide Observer,* 17 July 1869
James Warland	Echunga diggings	1877	2 diamonds	*The Lantern,* 7 April 1877
A digger (prob. John Glover)	Long Gully	1877	2 diamonds — 1 weighing 5½ cts	Mem. of Proc. by Warden of Goldfields, 10 August 1877
Davis	Echunga diggings	1877	1 small diamond	Mem. of Proc. by Warden of Goldfields, 24 February 1877
Col. Biggs	Echunga	1877	1 weighing 3½ cts	*The Lantern,* 21 April 1877
?	Echunga	?	9¼ cts (prob. a misprint — 9¼ grs = 3 cts)	Brown 1908
John Glover	Poor Man's Hill	?	2 diamonds. One about 14 grs plus smaller one. 5¼ cts exhibited in Paris. Now in S.A.M. collection.	Hales 1909
Alfred Rennells	Poor Man's Hill	?	1 — 'Rennells Vision' diamond	*Advertiser,* 16 June 1909
Tom and Robert Hall	New Rush Hill	?	Claim to have found the first stone	Hales 1909
John Whillis	Poor Man's Hill	?	1 small diamond	Hales 1909
Tom Hall	Poor Man's Hill	?	1 between 2 and 3 grs	Hales 1909
Loveland, Goodliffe, Longman, Jimmy Gibbs, Sam Ewen, Harry Pitcher	New Rush Hill	?	Diamonds were found by these diggers	Hales 1909

anomalies of possible kimberlitic nature on the Old Echunga Diggings, Jupiter Creek Diggings and Biggs Flat area. Samples from these anomalous zones contained zircon, chromite and corundum which may be of kimberlitic origin, but no kimberlites were located (Gerdes 1987).

Western Queen (South Australia) Pty Ltd explored for diamonds in the Lobethal area of the Mount Lofty Ranges, 20 km north of Echunga, and found fresh picroilmenite indicator minerals suggesting possible kimberlites (Gerdes 1987).

In January 1987, John Popeskul, a fossicker, found a 0.91 ct diamond while panning for gold near National Dam on the Old Echunga Diggings.

Diamond Specimens from Echunga

Only five of the diamonds found at Echunga last century can be traced. The collection of the South Australia Department of Mines and Energy contains two small diamond crystals, and three stones (two uncut and one cut) are in the South Australian Museum collection

The largest of these is a fine brilliant-cut yellow diamond of 2.84 ct (Fig. 4). The gem was said to have originally been pale red in colour (Cloud 1883; Brown 1908), but to have changed colour in the 1950s as a result of being stored with radioactive minerals. This stone was probably the one cut from the 5 5/16 ct crystal found by John Glover in 1877 and displayed, together with another uncut stone, at the Paris Universal International Exhibition of 1878. Both were cut in London in 1879. The cut diamonds were returned to Australia and displayed at the International Exhibitions held in Sydney in 1879 and Melbourne in 1880 (Sydney International Exhibition 1879, Melbourne International Exhibition 1880) (Fig. 5). The South Australian Museum Curator's Monthly report of December

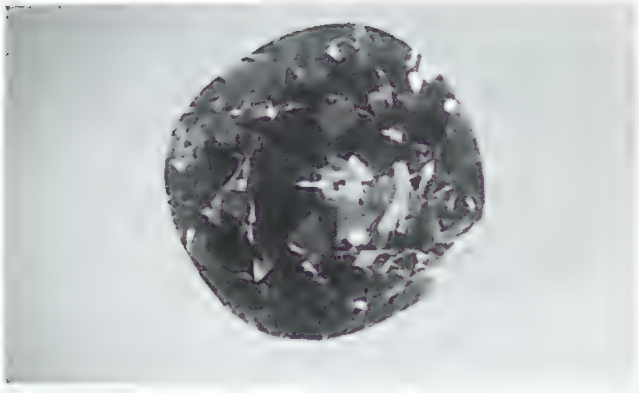


FIGURE 4. Brilliant cut diamond (2.84 ct and 9 mm across) from the collection of the South Australian Museum (G6500); this was cut in London in 1879 from a rough weighing 5 5/16 ct (photo: J.A. Forrest).

286 **Commissioners** for South Australia.

Collection of South Australian Minerals, prepared for the Commission by T. C. Cloud, A.R.S.M., F.C.S., F.I.C.

DIAMOND.

1 Brilliant cut diamond, from Echunga Gold Fields—weight in the rough, 5½ carats; present weight, 2⅞ carats. S.A. Government.
2 Brilliant cut diamond, from Echunga Gold Fields—weight in the rough, 3¼ carats; present weight, 1⅛ carats.
3 Diamond, natural crystal, exhibiting the planes of the triakis octahedron—weight, ⅛ carats; Echunga Gold Fields. H. Heutzenroeder.
4 Diamond, natural crystal, hexakis octahedron—weight, 1½ carats; Echunga Gold Fields. H. Heutzenroeder.

FIGURE 5. Catalogue of the Melbourne International Exhibition, 1880, giving details of four diamonds from Echunga. Three of these stones are now in the collection of the South Australian Museum.

1881 notes the purchase of a diamond, presumably the large cut stone in the Museum collection; the fate of the smaller cut stone could not be traced.

The two small uncut diamonds displayed at the Sydney and Melbourne Exhibitions are also in the South Australian Museum collection; these were acquired in 1949. The stones, a sharp trisoctahedron of 1.5 ct (Fig. 6a) and a distorted octahedron of 1 ct (Fig. 6b), were the property of Mr H.Y. Heuzenroeder, a Rundle Street chemist and coin collector, when exhibited. They were purchased by the Museum from Mr T.W. Hastings, Heuzenroeder's grandson in 1949 for £45. In a letter to Herbert M. Hale, the Museum Director at the time of the purchase, Hastings claimed that the two stones were exhibited in Paris in 1878, but these gems were cut in London after the exhibition. The *Adelaide Observer* of 17 July 1869 states that 'Mr Heuzenroeder of Rundle Street brought to our office on Tuesday two fine rough diamonds, weighing 1 1/2 carats and 1 carat, both of which were found at Echunga some time ago' (*Adelaide Observer,* 17 July 1869). Mr Heuzenroeder may have bought the stones from Mr Simpson of North Adelaide, who earlier offered two diamonds to the Museum in 1864 . The two diamonds are certainly some of the earliest found on the Echunga goldfields.

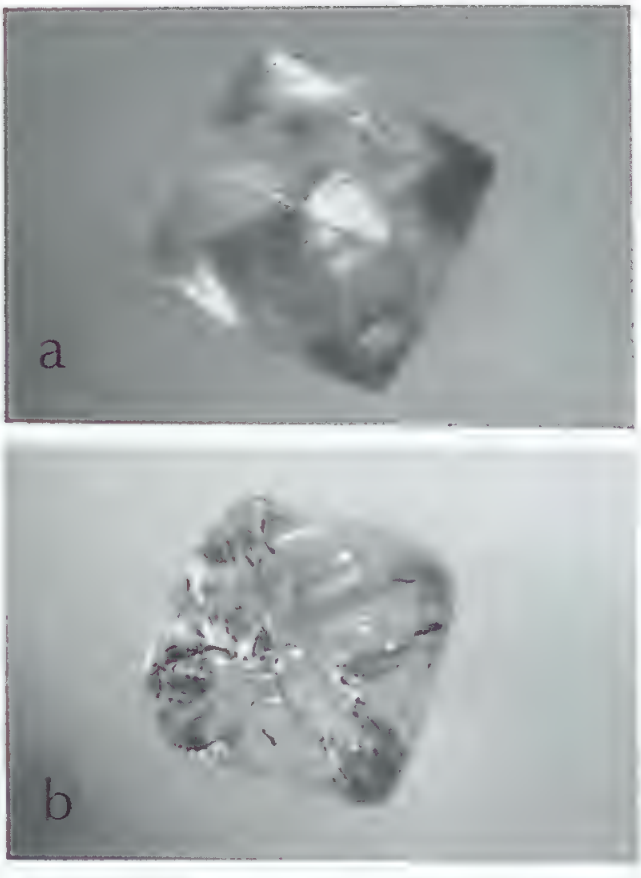


FIGURE 6. Uncut diamonds in South Australian Museum collection (G6505). These stones, exhibited by the South Australian Government at the Sydney and Melbourne International Exhibitions of 1879 and 1880, were purchased from Mr Hastings in 1945. (a) 1.5 ct sharp trisoctahedron, 6 mm across (photo: J.A. Forrest); (b) 1 ct distorted octahedron, 4 mm across (photo: J.A. Forrest).

The two diamonds held by the South Australian Department of Mines and Energy weigh 0.836 and 0.462 ct. Unfortunately, their history cannot been traced, but they may be the two stones offered to the Museum by Mr Simpson in 1864.[3] The gems are of good crystal shape and strongly yellow in colour (Fig. 7). The larger stone is a combination octahedral-dodecahedral crystal, and the smaller is a flattened dodecahedron (Hall & Smith 1983).

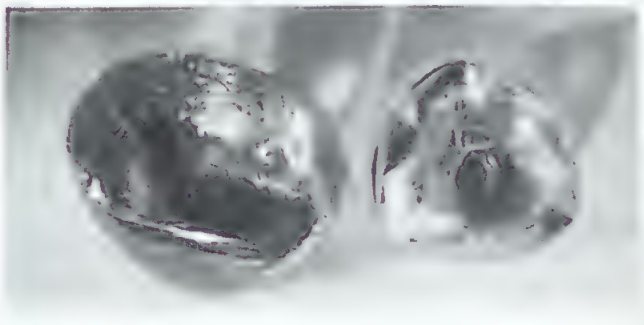


FIGURE 7. Two diamonds from the collection of the South Australian Department of Mines and Energy. The larger stone weighs 0.836 ct and is 5 mm across. The smaller stone, a flattened dodecahedron, weighs 0.462 ct and is 3 mm across (photo: J.A. Forrest).

The 0.91 ct diamond found on the Old Echunga Diggings in January 1987 is still in the possession of the finder. The stone has a slightly elongate, almost oval shape showing what appears to be a combination of octahedral and dodecahedral forms; it is pale straw yellow in colour (Fig. 8).

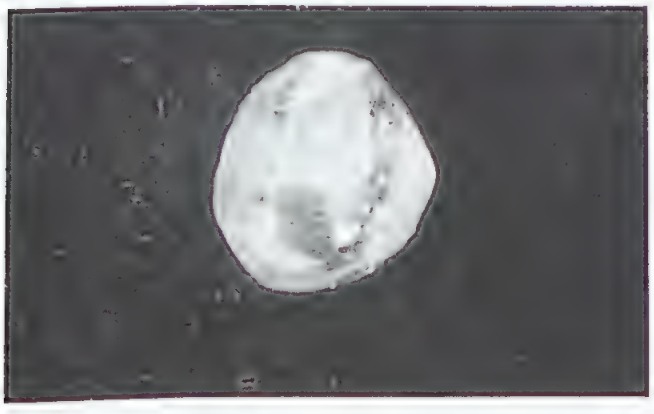


FIGURE 8. Diamond, weighing 0.91 ct (4 × 6 × 3 mm), found near National Dam on the Old Echunga diggings by J. Popeskul in January 1987 (photo: J.A. Forrest).

Other Diamond Localities in South Australia

Numerous kimberlite pipes and dykes have been found in county Kimberley, 250 km north of Adelaide. Microdiamonds were recovered from several of these, including the pipes at Pine Creek, Ketchowal, and Franklyn (Colchester, 1972).

A total of 140 microdiamonds were recovered during exploration of kimberlites near Eurelia, 20 km north of Orroroo, by Stockdale Prospecting in the early 1980s (Scott Smith *et al.* 1984). No larger diamonds have been found in either county Kimberley or the Orroroo kimberlites, and neither appear have of economic significance.

Brown (1908) reports recovery of a 1 ct diamond from auriferous gravel at Algebuckina, 900 km north-north-west of Adelaide, but no further details, including current location of this stone, could be traced. Little exploration appears to have taken place near this occurrence.

Acknowledgments

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Endnotes

1. Attempts to locate copies of the Dodd and Bean Reports were unsuccessful and information on their content is drawn from newspaper reports.

2. Reports by the Museum Curator on the progress of the Museum, November 1863 to 1882. *See* reports dated March 1880 and December 1881. Public Records office GRG19/168, Adelaide.

3. Letters and Memoranda received by the General Secretary concerning evaluations, donations and purchases of Museum specimens and apparatus, 8 December 1857–10 March 1865. *See* letters dated 26 February 1864 and 11 March 1864. Public Records Office GRG19/167.

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EARLY HUMAN OCCUPATION OF THE FLINDERS RANGES

R.J. LAMPERT & P.J. HUGHES

LAMPERT, R.J. & HUGHES, P.J. 1988. Early human occupation of the Flinders Ranges. *Rec. S. Aust. Mus.* 22: 139-168.

The climatic amelioration that followed the last glacial maximum (17-15 000 yBP) prompted more widespread human occupation of the Australian arid zone. Whereas the better watered Flinders Ranges were a focus of human activity as early as 15 000 yBP, the shores of Lake Frome became popular during generally moister conditions of 9.5-4 000 yBP, and the widespread occupation of the Strzelecki Desert, with its highly ephemeral surface water, took place mainly within the last five thousand years. Technological change accompanied these movements. The Kartan industry, dating to 15 000 yBP, is present at early sites in the Ranges, while small tools characterise the widespread recent sites. Lying temporally between these is an industry of core tools, shaped differently from those of the Kartan, found on the early Holocene Lake Frome sites. On the evidence of this and earlier investigations, the Kartan has an upland distribution, ranging from the hills of Kangaroo Island to the desert highlands of the north.

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Our research on early Aboriginal occupation of the Flinders Ranges, and adjoining areas of the arid zone of south-eastern Australia, began on temperate Kangaroo Island, several hundred kilometres to the south (Lampert 1981). There, attempts to date the Kartan industry, present only on surface sites, had met with limited success. The presence of this industry also on parts of the mainland close to Kangaroo Island, together with evidence for the separation of the island from the mainland by post glacial sea rise some 9 500 yBP (years Before Present), suggested a late Pleistocene age for the industry. This view received support from the absence of large core tools, which are the hallmark of the Kartan, from a number of sites on the island with ages ranging between 11 000 and 4 300 yBP. These sites have securely stratified occupation horizons containing acceptably large samples of an industry characterised by small adzes and scrapers made on stone flakes.

Lampert concluded from his Kangaroo Island research that the Kartan was a regional variant of the core tool and scraper tradition, the earliest Australian stone-working tradition yet recognised; that it dated back to the late Pleistocene; that it preceded an industry of smaller tools, made on flakes rather than cores, this succession being part of a trend towards smaller tool types throughout Australia; and that the later industry was essentially part of the mainland small tool tradition despite the absence from Kangaroo Island of later and more characteristic tool forms (Lampert 1981). Other more tentative hypotheses were raised, notably one concerning the differences between the Kartan and more widespread examples of the core tool and scraper tradition. Whereas large core tools predominate in the Kartan, such tools are smaller and fewer in other industries of the tradition, the much more common tool being a flake scraper. However, large core tools predominate in some early sites in South East Asia, lands from which Australia must have received its early human population. The similarity of these tools to those of the Kartan had been noted earlier (Tindale 1937; McCarthy 1940, 1941, 1943), although later research (Matthews 1966) showed that this relationship was not particularly close. This evidence raised the possibility that the Kartan was different from other industries of the Australian core tool and scraper tradition because it had retained tool forms earlier in origin. If this is the case, some Kartan sites should have ages in excess of 30 000 years.

To address such questions, there was clearly a need to locate the Kartan in stratified contexts that would allow its age and cultural associations to be determined more accurately. The discovery of suitable sites on Kangaroo Island and nearby peninsulas of the mainland seemed unlikely given the number of lengthy reconnaissances that had already failed in this attempt. Attention was turned to the Flinders Ranges where Cooper (1943) had reported the discovery of Kartan tools.

The northern sector of the Ranges seemed the more promising because, lying within the arid zone, it was subject to a cycle of deposition and erosion that could cover archaeological materials and expose them again to allow discovery.

In the event, investigations there illuminated not only the problem of the Kartan but also general questions about the antiquity and nature of human occupation in the arid zone of south-eastern Australia (cf. Gould 1971, Bowdler 1976, Horton 1981, Ross 1981).

The Setting

Present environment

Landforms

Structurally, by far the larger part of the Flinders Ranges (*see* Fig. 1) has developed from sedimentary rocks laid down between 500 and 1 000 million years ago. These rocks were compressed, buckled and fractured; they were uplifted slowly and eroded. In the arid northern Ranges, where vegetation is sparse, the intricate folding and faulting, and the effects of erosion, can be best appreciated. The landforms here are spectacular, the Ranges as a whole rising abruptly from the surrounding plains, and containing deep gorges, jagged ridges and enclosed synclinal basins or 'pounds', the best known of which is Wilpena Pound. Predominant among rock types is quartzite which grades out into sandstone and siltstone. Limestone is fairly extensive, some igneous rocks are present in the Mt Painter region, and there are a few small outcrops of silcrete. To the north, the Ranges become more subdued and eventually terminate in the dunefields and stony plains of the Strzelecki Desert.

Sandy plains some 30 km in width separate the northern Ranges from Lake Frome to the east and Lake Torrens to the west. These lakes are huge saline playas that rarely contain water. Streams flowing from the Ranges soon peter out, reaching the lakes only rarely. Under this regime, the streams drop their bedload of sediments within a short distance, causing alluvial fans to form on the piedmont.

Climate and vegetation

The northern Ranges receive an annual rainfall slightly less than 300 mm which decreases from south to north, the northern limits falling below the 250 mm isohyet. These average figures are deceptive because of considerable variation in rainfall from year to year. Rainfall is 50% greater in the Ranges than on the surrounding plains which receive only 200 mm, a figure that diminishes to a mere 125 mm in the heart of the Strzelecki Desert and at Lake Frome. As well as having a higher rainfall, the Ranges have deep shady chasms with a rocky substrate that allows the retention of surface water in pools.

The plains, by contrast, have only highly ephemeral streams and salt pans, plus a few widely spaced artesian springs with water that is not always drinkable. The northern Ranges are thus a reasonably well-watered strip within an arid region.

Vegetation communities in the Ranges vary mainly in accordance with soil types which in turn reflect the kinds of parent rock and weathering processes to which they have been subjected. Soils range from skeletal soils, found mainly at higher latitudes, through red brown soils and podsols, to the deep alluvial soils found in valley bottoms (Kuchel 1980: 69).

Shrubland dominated by various species of *Acacia, Cassia* and *Eremophila* is common, particularly on the stony soils of upper hill slopes. Native pine (*Callitris columellaris*) and sheoak (*Casuarina stricta*) are found on lower slopes and flats. Calcareous podsols developed on a sandy base are colonised mainly by mallee (*Eucalyptus* spp.) with spinifex (*Triodia irritans*) occurring on more mobile sands. Plants of the family Chenopodiaceae, including salt bush (*Atriplex* spp.) and blue bush (*Maireana* spp.) are found on stony flats and hill slopes, notably at the northern end of the Ranges and on the Lake Frome plain. Valley bottoms and stream courses support the lofty river red gum (*Eucalyptus camaldulensis*), specimens of which in the better watered gorges reach an enormous size.

Past events

Before 45 000 yBP

Evidence from this early period is sparse, but thermo-luminescence (TL) dates for the onset of dune building in the northern Strzelecki Desert at least 250 000 yBP (Gardner *et al.* 1987), indicate that desert conditions were in place well before human occupation of the continent. In the Willandra Lakes, just outside the present arid zone, well-developed soils below lake bed deposits give evidence for dry conditions from 120 000–45 000 yBP (Bowler & Wasson 1984).

40 000–25 000 yBP

Significantly wetter conditions throughout southern Australia are shown by a variety of evidence. Lakes filled in the Willandra system and in south-eastern South Australia (Bowler 1971). Rivers of the Murray–Darling system were up to four times their present width (Pels 1964, Bowler *et al.* 1976). Lake Eyre covered three times its present area and was up to 17 m deep (Twidale 1980: 30).

Lake Frome experienced a high water phase minimally dated by C-14 to 36 800 ± 1 700 yBP from Coxiella shells in a beach ridge, while a dune thought to be associated with rising lake levels has a TL date of 48 000 ± 8 900 yBP (Gardner *et al.* 1987).

During this moist phase, high rates of runoff and erosion in the Ranges produced the immense

FIGURE 1. Places mentioned in text.

alluvial fans that form the pediments of hill slopes and extend outward across valley bottoms. Collectively, these sediments are known as the Pooraka Formation (Williams 1973). They are up to 10 m thick where cut through by Hookina Creek, just north of Hawker township. Radiocarbon dates indicate that this formation had begun to build up before 38 000 yBP and was completed by 30 000 yBP, after which the absence of sedimentation allowed a soil profile, known as the Wilkatana Palaeosol, to develop on its surface. Bones of Pleistocene fauna, including *Diprotodon,* have been recovered from deep sediments of this formation along Hookina Creek.

25 000–20 000 yBP

Conditions became cooler and drier throughout southern Australia. The Willandra lake levels were low and fluctuating; at Lake Frome there was a change from lake deposits to dune building; in the Strzelecki Desert extensive sandy clay dunes began to form (Bowler & Wasson 1984).

20 000–15 000 yBP

This was the coldest and most arid phase, with lakes drying up and aeolian activity at its most intense. The Willandra system became almost completely dry; dunes were formed around Lakes Torrens and Frome, and continued to be built in the Strzelecki Desert. Near Edeowie Creek in the northern Ranges, dunes were formed on top of sediments of the Pooraka Formation. Dissection, by irregular stream action, of fan and valley fill sediments of the Pooraka Formation began at this time, and continues today (Williams 1973).

15 000–10 000 yBP

This period was one of transition between earlier intense aridity and later, moister and warmer conditions. Dune building ceased in the Strzelecki Desert.

These conditions allowed the formation of such soils as the Motpena Palaeosol, dated to *c.* 12 000 yBP, and present in the northern Ranges on Edeowie and other dunes (Williams 1973).

10 000–5 000 yBP

More frequent high water levels at Hawker Lagoon in the Flinders Ranges (this report) and at Lake Frome, associated with greater vegetation cover (Singh 1981), indicate moister and warmer conditions, at least in the south-eastern sector of the arid zone, for any time during the past 30 000 years. Lakes near the south-eastern coast of South Australia and on Kangaroo Island provide evidence for similar wetter conditions at much the same time (Dodson 1974a, 1974b, 1975; Dodson & Wilson 1975; Lampert 1981).

After 5 000 yBP

Drier conditions began to return reaching a maximum around 2 000 yBP when the climate was slightly more arid than it is today (Bowler *et al.* 1976).

Reconnaissance of the region

A major aim of field research in the Ranges was to locate subsurface Kartan sites which could be excavated to provide the sort of information unavailable from the surface sites encountered previously. This information included the age of the Kartan; the nature of the 'complete' industry e.g. whether it was as dominated by large core tools as surface sites had suggested; and the stratigraphic relationship of the Kartan with small tools. Another interest developed during research lay in the geographical spread of Kartan *vis-a-vis* small tool sites over a broader region than the Ranges alone since differences might reflect the pace of human colonisation of the arid zone.

North of the Ranges

In 1979, we reconnoitred transects through the Cooper Basin and Strzelecki Desert as well as the northern Flinders Ranges (Hughes & Lampert 1980; Lampert & Hughes 1980). In the desert regions north of the Ranges we examined approximately 100 sites, all of which are of late Holocene age judging from the ubiquitous presence of tools typical of the small tool tradition, the almost total absence of core tools and large scrapers, and the stratigraphic position of these in the unconsolidated surface sands of dunes. No artefact was seen in the consolidated sediments that form the dune cores, and date back 15 000 to 18 000 years, despite numerous deep exposures through them. At Lake Murteree, stone tools protruding from the eroded slope of a dune core appeared to be *in situ,* but later excavation showed the tools lie in a slope washed skin, consisting of more recent sands, covering the eroded face of the dune. In deeper excavation at this site, no artefact predating the dunefield was found. This had seemed a particularly promising site for early occupation, being adjacent to a waterhole and near an outcrop of high quality silcrete from which tools at the site had been flaked. The absence of evidence at such a favourable location suggested that human presence before the late Holocene was sparse enough to be generally below the threshold of archaeological visibility. However, people were not totally absent, as the JSN site shows (Wasson 1983). This site, some 50 km west of Lake Murteree consists of a lens of charred wood together with mussel shell, dated to *c.* 13 500 yBP and presumed to be an Aboriginal fireplace.

Mound springs

These stretch in a broad arc that follows the south-western edge of the Great Artesian Basin from Lake Frome, across the northern margin of the Flinders Ranges, along the south-western shore of Lake Eyre, to Dalhousie on the western edge of the Simpson Desert. The springs are natural outlets for artesian water containing a number of soluble salts which solidify to form mounds as the water evaporates.

The water from these varies considerably in quality. A few springs have excellent drinking water, most are brackish but still potable, while some are biologically inert because of massive quantities of salts in solution. Except for the last, the springs support small areas of lush vegetation, as well as molluscs, amphipods and small fish. They attract such mammals as the red kangaroo, and birds that include ducks, the brolga and stilts. Although their output of water is low, the springs appear as oases in a region where the annual rainfall averages only 125 mm.

Every major spring complex has at least one large Aboriginal surface site adjacent to it (Hughes & Lampert 1985, Lampert 1985). Variations between sites in types of tools, kinds of raw materials, and core reduction techniques, are currently under investigation by S. Florek (University of Sydney). Like those in the Cooper Basin, these sites appear to have been occupied mainly in the late Holocene, judging from the presence of such small tools as pirris, tulas and microliths. Only occasionally are there a few artefacts in carbonate-solidified lower sand horizons to give a hint of sparse earlier occupation.

Sites in the Ranges

We examined a number of sites in the Ranges during our 1979 survey. Chambers Gorge and nearby Moorowie Well we assume to be Kartan judging from the presence of heavy core tools and the rarity of smaller flaked artefacts lying on the surface. However, the sparseness of artefacts generally, and the unlikelihood of finding stratified material in the skeletal soils of the rocky slopes on which the sites are situated, did not prompt any closer research. Only Hawker Lagoon, where stone tools of many types, including large core tools, seemed to be eroding from stratified dune horizons, offered the chance of finding dated sequences.

In the 30 000 to 38 000 years old sediments of the Pooraka Formation along Hookina Creek a quartzite core was found well embedded in the eroded slope of a gully. We accepted this as being *in situ* at the time (Lampert & Hughes 1980), but on a return visit after heavy rain Lampert noted how fluid the deposit became when wet. Whole blocks of sediment slumping downward and becoming embedded in hollows within lower levels, carrying with them material from the present surface, force us to revise our opinion of the stratigraphic provenance of this artefact. Despite the examination of many kilometres of exposures through the Pooraka Formation along the water courses, no sign was seen of human activity in these sediments.

Lake Frome

Lying about 30 km east of the northern Ranges, Lake Frome is a saline playa some 100 km long and 45 km wide. With an annual rainfall ranging between 100 and 125 mm, and an evaporation rate exceeding 2 200 mm, it is one of Australia's driest places. Because Lake Frome lies at the end of a long chain of ephemeral lakes and watercourses, substantial amounts of water reach it only rarely. Cooper Creek, which drains from south-western Queensland, must have sufficient discharge to flood Strzelecki Creek, then Lakes Blanche and Callabonna before water can reach Lake Frome.

On the western side of the lake a gravel beach 20 m higher than the present lake bed denotes a high stand of fresh water more than 30 000 years ago. Since then, apart from moist phases 9 500–8 000 and 7 000–4 000 years ago (Singh 1981), the lake bed has been almost continuously dry.

A survey of the western and southern shores revealed that artefacts are very rare around Lake Frome. A few sparse scatters of flaked stone, varying in density between one flake per 5 m^2 and one per 50 m^2 being found along the banks of Passmore River (Wilpena Creek), Balcoracana Creek and the channel joining Lake Frome with Lake Callabonna to the north. These sites are all within one kilometre of the lake shore. Except for one tula slug and a few core tools, the artefacts are all undiagnostic small flaked pieces.

Actual sites, that is, places where artefacts are concentrated within a definable area, are similarly rare; they are also small and have a low density of artefacts compared with sites in the Ranges. A report follows on detailed research at one of these, Balcoracana Creek, and comments on a second, Big John Creek.

Balcoracana Creek

The site is on the southern bank of Balcoracana Creek, about one kilometre upstream from the outlet of the creek into Lake Frome. Only on very rare occasions does the creek bed contain water. The nearby dunefield is interpreted by Dr R. Wasson (pers. comm., Gardner *et al.* 1987) as being source bordering rather than continental in origin.

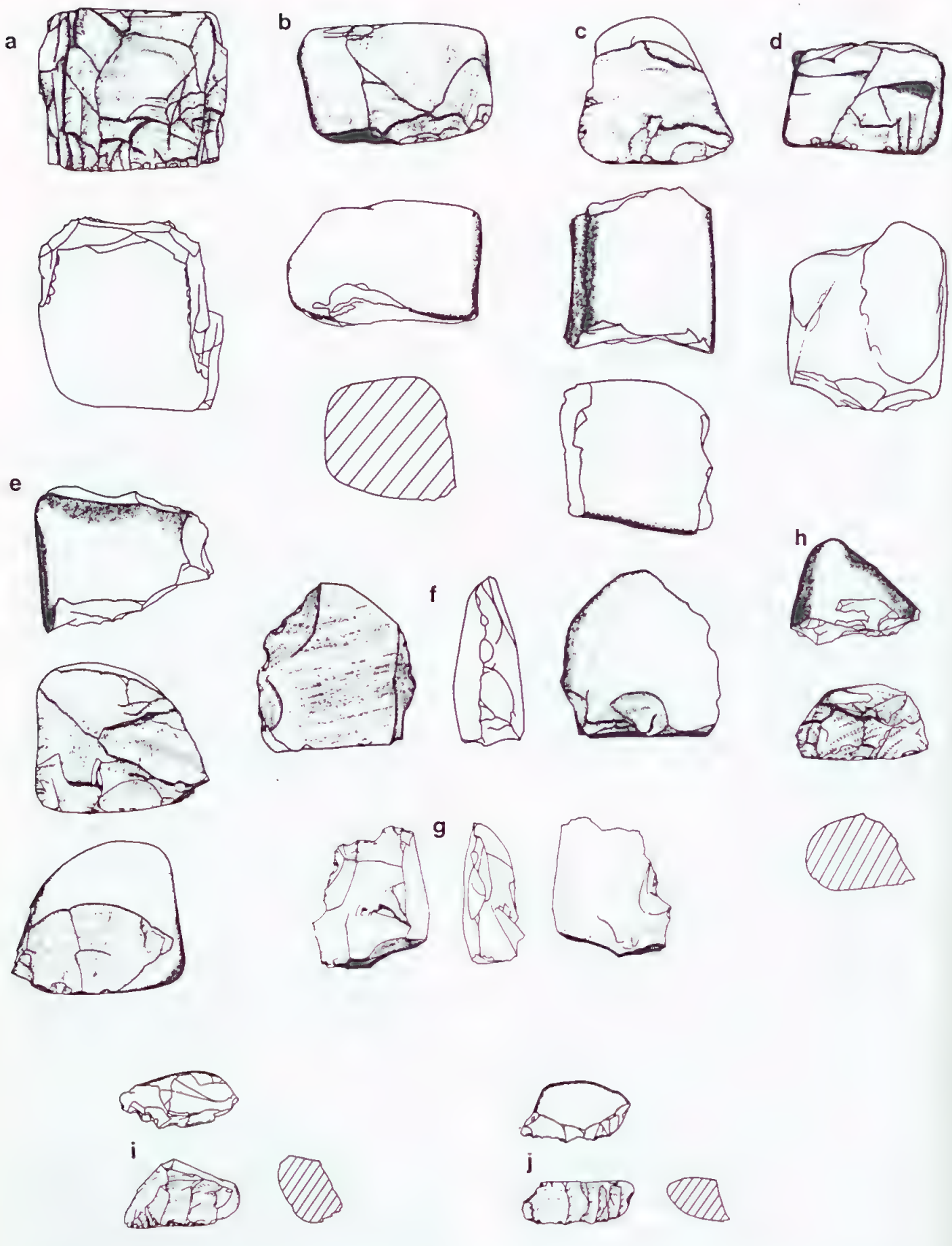

FIGURE 2. Artefacts from Balcoracana Creek: b, f and g are core tools from the carbonate palaeosol; a, c, e and h from the overlying sand; i and j are adzes from the overlying sand.

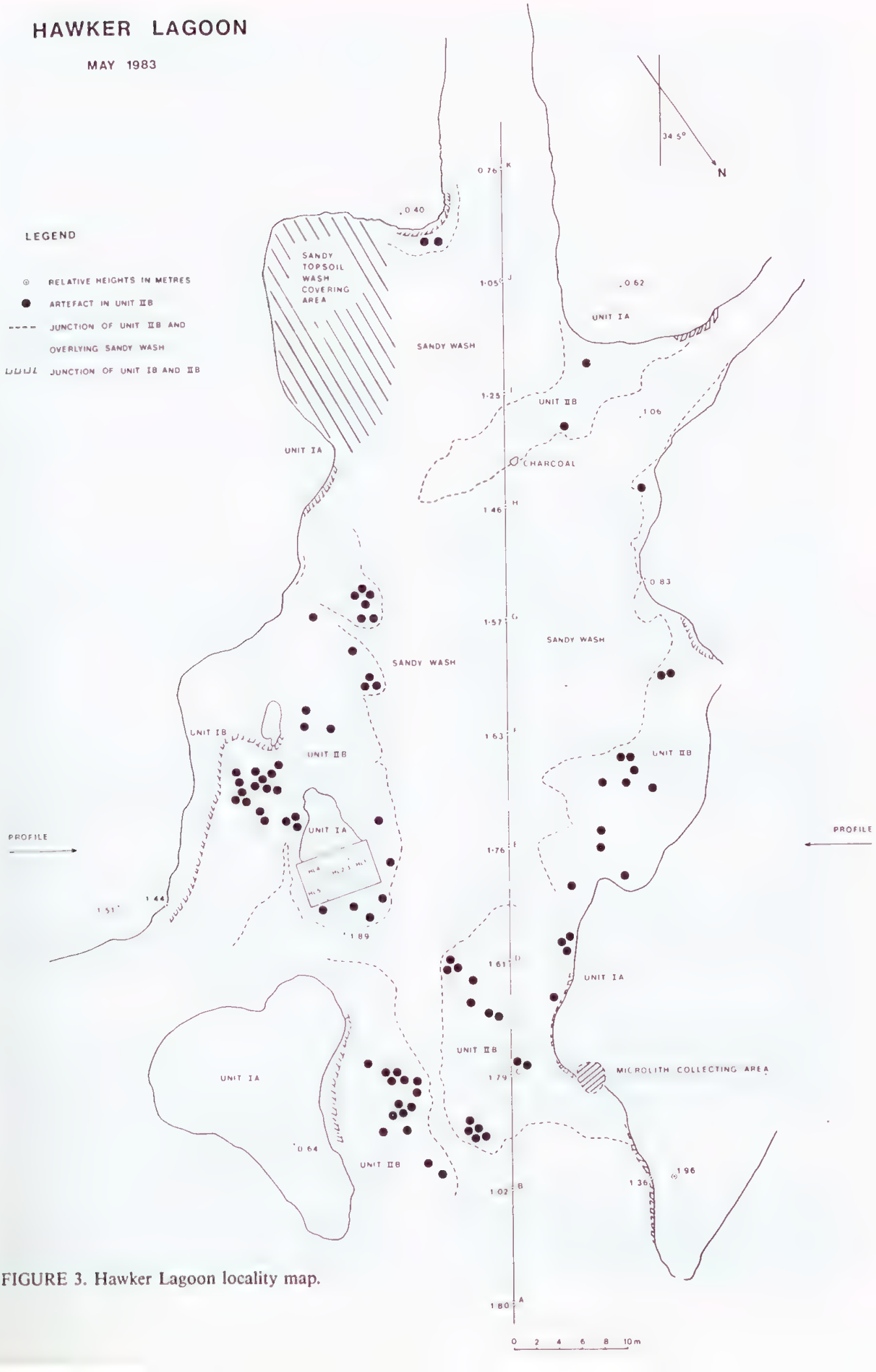

FIGURE 3. Hawker Lagoon locality map.

The site is in a dune blow-out, deflation having exposed the horizontally bedded carbonate horizon of a palaeosol. At the time of our investigation, artefacts lay scattered both on the surface of the carbonate and on the lower slopes of dunes surrounding the blow-out. During our initial appraisal (Lampert & Hughes 1980) we noted that artefacts lying on the sand appeared to be different from those on the carbonate, both in type and in whether or not the artefact was coated with carbonate. This suggested to us the possibility of identifying two industrial phases at the site through more careful scrutiny. In 1981, we revisited the site and collected, for closer examination, all stone artefacts, noting whether each lay on sand or on carbonate. We were accompanied by Drs R. Wasson and J. Ash who investigated the age and origin of the dune sands from which the artefacts had eroded.

The stone industry

The stone industry consists of 1 451 pieces of worked stone found within the blow-out. Two sorts of stone were used: silcrete that is variable both in texture and in colour, and a reef quartz that is somewhat granular in texture. A high frequency of rounded cortical surfaces on the artefacts shows that the raw materials were pebbles, possibly from pebble beds in the Eurinalla formation, exposures through which are located within two kilometres of the site.

A list of the various types of artefact is given below and in Table 1 but for some types (Fig. 2) a more detailed description follows in another section of this report.

Core tools

All of these are made on silcrete pebbles that vary widely in both texture and colour. Because some of the pebbles are water-rounded, sub-angular blocks rather than smoothly curved pebbles we have chosen to call the group core tools rather than pebble tools.

Flake scrapers

These are made on both quartz and silcrete, and include typical steep-edged forms at the heavier end of the range, while lighter specimens merge with adzes.

Non-tula adzes

All of these are made on silcrete. They are recognized by the characteristics listed by Lampert (1981: 134–142), and include one typical burren adze, but not all could readily be distinguished from some of the lighter scrapers.

Tula adze

Made on silcrete, this is a typical tula slug as described by McCarthy (1976: 31).

Hammers

Made on silcrete, they display the pitting that characterises percussion stones generally (McCarthy 1976: 55–9).

TABLE 1. Balcoracana Creek: artefact types and their contexts.

	On palaeosol	On sand	TOTAL	
			Number	Weight in grams
Core tool	5	10	15	5 510
Flake scraper				
silcrete	1	5	6	192
quartz	3	8	11	347
Non-tula adze		11	11	163
Tula adze (slug)		1	1	5
Hammer	2		2	2 277
Trimming flake	1	3	4	162
Silcrete core	14	15	29	4 867
Silcrete flake	76	147	223	1 145
Quartz piece	327	822	1 149	10 665
Total number	429	1 022	1 451	
Total weight	9 349	15 984		25 333

Trimming flakes

All are of silcrete. The small flake scars along the platform suggests that these flakes result from the resharpening of core tools. They are similar to those found at Kartan core tool sites on Kangaroo Island (Lampert 1981: 44).

Silcrete cores

Unlike core tools, these are recognised by the multi-directional removal of primary flakes, and the absence of a working edge along which smaller flakes have been removed.

Silcrete flakes

Quartz pieces

Because of the coarseness of the raw material not many pieces could be recognised either as cores or as flakes, and hence are simply termed quartz pieces. Unlike the quartz component of the industries from most of the early to mid-Holocene sites on Kangaroo Island, no bipolar cores were found at Balcoracana Creek, but whether this is due to a real absence of bipolar flaking or to our inability to recognise it among the coarse material is unknown.

Time differences within the stone industry

Scattered over the surface of the palaeosol and on loose sand remaining from overlying dunes, the stone industry presented the usual problems of age and association that make surface sites difficult to assess. To look for temporal divisions within the material we examined two lines of evidence.

One was the presence or absence of a carbonate coating on each stone artefact, our assumption being that tools coated with carbonate had lain formerly *in situ,* near the carbonate rich palaeosol, and are therefore relatively old; while tools from which carbonate is absent had been provenanced in higher dune levels, which contain much less ground carbonate, and are therefore younger (cf. Bowler *et al.* 1970: 48). Such a strategy had occurred to us during our first visit to the site in 1979, when initial counts of tool types showed carbonate to be present on all except one of the 14 core tools but absent from the three adzes then located (Lampert & Hughes 1980). Following a complete collection of artefacts in the blow out during our 1980 field season, these relationships were examined more rigorously.

Table 2 shows frequencies for the occurrence of carbonate on various types of artefact, while Table 3 lists the statistically significant relationships using X^2. The results confirm our initial observation that more core tools than adzes are encrusted with carbonate. The same difference occurs between core tools and flake scrapers, while another interesting result is the much greater rarity of carbonate on quartz pieces than on silcrete flakes.

Before deducing from these differences an historical progression of artefact types, it is worth looking at another possible cause. Observations of sections naturally eroded through several alluvial fans in the region show, beyond doubt, that carbonate coating is removed from pebbles following their exposure, presumably by wind and rain. From this evidence it is possible that more core tools are carbonate-coated because they were exposed only recently, while adzes have lain for longer on the surface. However, this would again suggest a greater depth below the surface for the provenance of the core tools.

Of the two mechanisms considered so far for differences in carbonate coating, both suggest that core tools generally lay buried deeper than adzes and are therefore older. We see no other likely cause for the pattern of carbonate encrustation. The silcretes used for both tool types are broadly identical. Although core tools have more cortical surfaces than flake tools, carbonate coats the flaked surfaces of core tools as much as it does the cortex. There is no obvious lateral variation in the distribution of the two tool types. We therefore tentatively accept this evidence as support for the greater antiquity of core tools at the site.

TABLE 2. Balcoracana Creek: carbonate coating on artefacts.

	Carbonate coated	Not carbonate coated
Core tool	14	1
Flake scraper	3	14
Non-tula adze	3	8
Tula adze (slug)		1
Silcrete core	18	11
Silcrete flake	52	171
Quartz piece	7	1 142

A second method for seeking temporal divisions within the assemblage was to record during collection whether each artefact lay on the palaeosol or on the overlying sand. We reasoned that, by natural means at least, artefacts would have moved downward, but could not have moved upward, as the blowout developed. Artefacts found on the palaeosol would thus include a larger number originally from lower levels, while a greater number of those from the dune flanks would be from upper levels. Initially we divided the dune flanks into two stratigraphic levels, consolidated lower and loose upper sand, but because the samples were too small to allow us to make use of this separation, we combined them and simply compared palaeosol with sand.

Table 4 shows the distribution of artefact types on palaeosol and sand (Table 3 listed the differences that can be supported statistically). Adzes are more likely to be found on the sand than are core tools, but this difference is at the 'probably significant' level, as is the increase in quartz pieces over silcrete flakes on the sand.

Like carbonate coating, this is not firm evidence for historical changes in the stone industry. However, the two lines of evidence do support each other. Compared with core tools, fewer adzes are carbonate-coated and fewer are from the palaeosol. Similarly, fewer quartz pieces than silcrete flakes are either carbonate-coated or from the palaeosol. Further, there is a strong positive correlation between carbonate coating, and palaeosol as a context, for all artefacts (Tables 3 and 4). We conclude tentatively that, within an industry containing core tools and flake scrapers, adzes became popular later, and the use of quartz increased.

Dating

Several radiocarbon (C-14) and TL dates (Gardner *et al.* 1987) provide a time framework for the build-up of the dune series from which the artefacts have eroded (Table 5). Dates for the palae-

osol, both from carbonates formed within it, and from land snails (*Sinumelon* sp.) embedded in its exposed surface, show that the antiquity of the earliest tools must be less than 13 000 yBP. It is presumed that the carbonate-coated artefacts were eroded out of carbonate rich sands, dated by TL to *c.* 10 000 yBP, lying immediately above the palaeosol. Other artefacts, without carbonate on their surfaces, came from more recent sands, which continued to accumulate until after 5 000 yBP.

As demonstrated later (Tables 5–7), the industry as a whole is typologically akin to that from the Kangaroo Island site of Pigs Water Hole, for which an early Holocene date is favoured (Lampert 1981: 88), while the scrapers and non-tula adzes are like those from several Kangaroo Island sites dated between *c.* 11 000 yBP and *c.* 4 300 yBP (Lampert 1981). Dated tulas from elsewhere in south-eastern Australia indicate that the tula found at this site dates to within the past 5 000 years, while evidence already discussed suggests that this specimen was deposited during the latter part of the site's occupation. Assemblages of late Holocene age found in the lower Murray Valley (Hale & Tindale 1930, Mulvaney 1960) and the Flinders Ranges (this report) contain a much higher proportion of typical small tools (pirris, tulas and backed blades) than does Balcoracana Creek with its single specimen, again suggesting that the site was occupied for some time before such tools became popular.

To accommodate all of the above evidence, much of the occupation of Balcoracana Creek must have occurred during the first half of the Holocene, the site being occupied less intensively after 5 000 yBP. Looking beyond the site itself, such a sequence of events would explain also the pattern of other, smaller, surface sites along the creek bank towards the shore of Lake Frome. These are visible only in deep blow-outs; no artefacts can be seen in higher sands that form the general land surface. Core tools and flake scrapers, but no typical small tools, were seen during our reconnaissance of these sites.

Specific typological relationships

To compare core tools with those found at South Australian sites further south, we measured the same attributes used by Lampert (1981). Tables 5, 6 and 7 set out the mean and standard deviation values for attributes measured on the interval scale, and compares these values with those derived from pebble tool samples from sites on Kangaroo Island. As significance levels for the *t*-tests show, the Balcoracana Creek tools are similar to those from Pigs Water Hole, but unlike pebble tools from Kartan sites on Kangaroo Island (Lampert 1981). Using a discriminant function classification procedure on the same data, 60% of the sample was grouped with Pigs Water Hole and 31% with Kartan.

TABLE 3. Balcoracana Creek: results of hypothesis tests.

Hypothesis tested	Significance level		
	.05	.01	.001
1. Carbonate coating			
On more core tools than adzes			+
On more core tools than scrapers			+
On more core tools than cores	+		
On more silcrete flakes than quartz pieces			+
2. Context			
More adzes than core tools on sand	+		
More adzes than other flaked tools (core tools and scrapers) on sand	+		
More quartz pieces than silcrete flakes on sand	+		
3. Carbonate coating related to context			
Fewer carbonate-coated artefacts on sand			+

TABLE 4. Balcoracana Creek: distribution of artefacts with carbonate coating.

	Carbonate coated	Not carbonate coated
On palaeosol	35	394
On sand	68	954

Turning to attributes measured on the nominal and ordinal scales, there are no significant differences between the same three samples in the characteristics of edge damage and edge shape specified by Lampert (1981). But in the orientation of the worked edge, most of the Balcoracana Creek tools are end-worked, while most of those from Kangaroo Island are side-worked, these differences (using X^2) being significant for Kartan and probably significant for Pigs Water Hole. Because end-worked tools should, almost by definition, have a shorter working edge than those that are side-worked, these results are consistent with the differences in 'percentage of retouch' (Tables 5, 6 and 7) between Balcoracana Creek and the Kangaroo Island sites.

To compare the Balcoracana Creek scrapers and non-tula adzes with 'scraper/adzes' from Kangaroo Island, we combined the two categories, and measured the same attributes recorded by Lampert (1981). Table 7 sets out the mean and standard deviation values and compares these with the values for Pigs Water Hole scraper/adzes. The Balcoracana Creek tools are somewhat larger and are less steeply

TABLE 5. Core tools from Balcoracana Creek (BC) compared with Kartan pebble tools (Lampert 1981) by univariate *t*-tests. S.D. = standard deviation, N = sample size.

Attribute	Significance Level NS	.05	.01	.001	Mean (S.D.) BC (N = 15)	Mean (S.D.) Kartan (N=116)
					15	116
Length				+	74.6 (14.0)	106.6 (20.0)
Breadth				+	64.5 (13.3)	74.6 (12.1)
Height	+				53.3 (14.7)	55.4 (9.9)
Breadth/length	+				115.6 (11.7)	145.2 (29.9)
Height/breadth		+			129.5 (43.5)	137.8 (28.8)
Retouch length				+	80.5 (36.5)	155.3 (57.3)
Retouch percent				+	36.1 (13.6)	51.9 (16.5)
Angle edge				+	87.6 (2.4)	80.6 (8.9)
Weight				+	344.4 (221.2)	520.6 (199.4)

TABLE 6. Core tools from Balcoracana Creek (BC) and Pigs Water Hole (PWH) compared by univariate *t*-tests. S.D. = standard deviation, N = sample size.

Attribute	Significance Level NS	.05	.01	.001	Mean (S.D.) BC (N = 15)	Mean (S.D.) PWH (N = 12)
Length	+				74.6 (14.0)	71.7 (12.3)
Breadth	+				64.5 (13.3)	55.6 (8.0)
Height	+				53.3 (14.7)	46.7 (12.3)
Breadth/length	+				115.6 (11.7)	113.4 (29.9)
Height/breadth	+				129.5 (43.5)	131.4 (46.5)
Retouch length	+				80.5 (36.5)	103.2 (32.8)
Retouch percent				+	36.1 (13.6)	82.7 (5.2)
Angle edge	+				87.6 (2.4)	82.8 (5.2)
Weight	+				344.4 (221.2)	236.7 (137.6)

TABLE 7. Scrapers/adzes from Balcoracana Creek (BC) and Pigs Water Hole (PWH) (Lampert 1981) compared by univariate *t*-tests. S.D. = standard deviation, N = sample size.

Attribute	Significance Level NS	.05	.01	.001	Mean (S.D.) BC (N = 28)	Mean (S.D.) PWH (N = 24)
Length				+	38.0 (6.7)	30.5 (7.4)
Breadth			+		28.4 (6.3)	23.6 (5.6)
Height		+			15.3 (5.0)	12.3 (4.7)
Breadth/length	+				137 (27.2)	130.8 (22.4)
Height/breadth	+				206 (92.2)	207 (87.9)
Retouch length				+	38.2 (14.4)	27.7 (7.8)
Retouch percent	+				35.5 (13.3.)	31.5 (8.5)
Angle edge		+			63.8 (7.0)	69.3 (8.0)
Weight		+			17.8 (13.4)	11.3 (8.8)

retouched, but have the same general shape of the Pigs Water Hole tools. Also, the proportion of tools that are side-worked does not differ significantly between the sites. Scanning the data for other Kangaroo Island sites, the same relationships appear to be true also between these sites and Balcoracana Creek, even though there is noticeable variation between Kangaroo Island sites in scraper/adze typology (Lampert 1981: 136–137).

Further, the proportion of core to flake tools does not differ significantly between Balcoracana Creek and Pigs Water Hole. The two sites exhibit a fairly close relationship in their stone industries, perhaps partly a reflection of their broad similarity in geographical region and antiquity. However, before these industries can be looked upon as useful regional or chronological markers, a wider sample of dated sites must be examined. Such research is currently under way.

Big John Creek

This site was investigated by Lampert on the advice of geomorphologist, Dr J. Bowler (Museum of Victoria), who had reported the presence of large, carbonate encrusted artefacts lying on the surface of the 20 m beach fringing the western shore of Lake Frome. The artefacts lay on a sector of the beach that had been cut through by Big John Creek, an intermittent channel carrying runoff from the Ranges towards, but rarely reaching the lake. Their presence there invited speculation that they may be associated with high lake levels over 30 000 years ago.

In the event, the artefacts were found to lie, as a lag deposit, not only on the ancient shoreline but also on the stratigraphically more recent Coonarbine Formation, a broad series of sediments ranging in age between 26 000 yBP and present (Callen 1975, Callen & Tedford 1976, Wasson 1983). The distribution of the artefacts followed the creek banks, not the beach.

Within an area of some 400 m^2, on the part of the beach that is also the south bank of the creek, the industry was examined in more detail, but not collected. The only formal tool type recognised was a core tool, most of which are end- rather than side-worked (8 end, 4 side, 6 side-end), and similar therefore to those from Balcoracana Creek, only some 30 km to the south. On this evidence, as well as that of stratigraphy, the industry is likely to be early Holocene in age.

Summing up at Lake Frome

The main phase of human occupation of the Lake Frome shoreline occurred during early Holocene times, the principal evidence being provided by sites on the lower courses of creeks a kilometre or two upstream from the lake shore itself. The rarity of typical small tools, given the fact that these are usually abundant on late Holocene sites, indicates only sporadic visits by people within the last 5 000 years. This pattern of occupation fits well

with the palynological evidence which shows a moister phase with more luxuriant local vegetation 7 000–4 000 yBP, after which conditions became as arid as they are today (Singh 1981). The popularity of creeks flowing from the Ranges as camping places suggests that these watercourses had a more reliable discharge, and the Ranges, a higher rainfall, than that of today.

Hawker Lagoon

The setting

Hawker Lagoon (Fig. 3) lies towards the northern end of a synclinal valley, known as Wilson Pound, just 8 km west of Hawker township. The valley is between steep quartzite ridges, Yourambulla Range to the east and Yappala Range to the west, which converge to a narrow gorge at the northern end. At Hawker Lagoon the valley floor is about 2 km in width.

The Lagoon itself is a canegrass swamp slightly less than 1 km wide which a local resident, Mr F. Teague, has seen full of water only three times in the last 40 years. It contains small amounts of water more frequently than this, but most of the time is a completely dry depression that supports a thicket of cane grass.

On the southern shore of the swamp is a lunette rising to some 10 m above the lowest point in the swamp bed. The position of a lunette on the southern rather than the, more usual, eastern shore (e.g. Bowler 1971) is explained by the north–south alignment of the valley which protects the swamp from prevailing westerly winds but exposes it to parching winds from the north.

Being near the head of the valley, the catchment of the swamp is small, consisting only of the slopes of the eastern and western ridges, and the short stretch of valley to the north as far as the watershed less than 2 km distant. The swamp has two outlets, one on each side of the lunette, from which water flows southward, eventually forming a well-defined water course (Wilson Creek).

Dunefields extend along the lower hill slopes and, in places, encroach, upon the valley floor. The source of sand, both for these dunes and the lunette, is ultimately the quartzite ridges. Sand, washed downslope into the depression, was transported by northerly winds to form the lunette. Because the largest dunefields are immediately south of the lunette, deflation of the lunette has probably contributed sand to dune formation down wind.

Sites

In many places sand has been stripped away, by deflation or gullying, to expose stone artefacts, the densest concentrations being beside the two outlet channels. Artefacts along the eastern channel are emerging from the lunette itself and extend southward only as far as the outer rim of the lunette, while those beside the western channel are eroding from a dunefield and extend from the south-western shore of the swamp to a point some 300 m south of the lunette. Sites on the western side of the valley are even more extensive than this, reasonably dense concentrations of artefacts being found in exposures through the dunefield some 800 m south of the swamp. Smaller sites are present for a greater distance, and occur sporadically along the banks of the creek until at least the southern end of the valley, some 3 km from the swamp.

The concentration of artefacts around the western outlet channel is not only large but also very dense, reaching 400 pieces of flaked stone per square metre in places, and having an average density between 100 per m^2 and 150 per m^2. There is great variety too, both in artefact types and in raw materials: large cores, core tools and flakes made of local quartzite, grindstones of sandstone, and such small tools as pirris, microliths and tulas, made of a wide variety of imported, fine-grained silcretes and cherts.

During our initial inspection of Hawker Lagoon, we discovered a large core tool apparently *in situ* in a compact lower horizon of the dunefield along the western side of the valley about 300 m south of the swamp. We also noticed that microlithic material was eroding from the uppermost sands, suggesting the presence of a two phase industrial sequence. To test this hypothesis, Lampert returned to the site for several seasons of excavations while Hughes visited less frequently to investigate the sedimentary history.

Site stratigraphy

The north-western sector

The main excavation trench called HL1 (an abbreviation of HL1–5 shown on Fig. 4) was opened up in the richest part of the concentration of artefacts in the dunefield, just beyond the western end of the lunette. Examination of stratigraphy exposed in the side of a gully (Fig. 4) at this point had revealed four superimposed layers of sand:

1. Unit IA, the top unit, of loose orange sand (Fig. 5: 1), from which microlithic material was emerging;

2. Unit IB, the middle unit, of grey brown compact sand (Fig. 5: 3), in which no artefact was seen;

3. Unit IIA, not present in this part of the site.

4. Unit IIB, the bottom unit, of tightly bonded, almost rock hard, red sand (Fig. 5: 5), from which core tools, cores and large flakes appeared to be eroding.

5. Unit III, mottled yellow and grey clayey sand without artefacts.

In this gully and along the edge of the dunefield facing the swamp units IA and IB, and the top few centimetres of Unit IIB had been stripped by erosion. The exposed surface was of the hard unit IIB material, on which some artefacts lay and others seemed to be still *in situ*. After our experiences at Lake Murteree and at Hookina Creek (this report), there were obvious dangers in accepting artefacts as being *in situ* without thorough investigation. Therefore, in a residual in the gully, where all three strata were superimposed, a trench 4 × 2 m was opened up. Artefacts were found in all three units but not in sufficient quantity in Unit IIB to allow the bottom industry to be characterized, nor was charred wood suitable for dating found. Also, the hardness of this unit made excavation difficult and very slow. Three more seasons were needed, and the trench was extended to a total of 4 × 6 m, before a reasonable sample of artefacts, and a carbon sample of acceptable quality for dating were obtained.

Having established through excavation that artefacts are unquestionably embedded in Unit IIB, we increased the sample by removing those emerging from IIB sediments exposed in the gully floor. Before removal, the matrix around each artefact was half sectioned to a depth of 20 cm to make sure it was in undisturbed unit IIB sand and not a slope washed skin. In all cases the matrix remained consistent, through depth, with the stratified unit IIB sands in the main excavation. Therefore, artefacts were judged to be *in situ*.

Dating of HL1

Radiocarbon dates from Trench HL1 are shown in Table 8. The single soil carbonate date (Unit III) provides only a minimum age for the sediments themselves. Judging from its wide divergence from the consistent series of charcoal dates above, the carbonate formed much later than Unit II sediments. Also worthy of comment is the modern date for Unit IA, a horizon that must have suffered post-occupational wind disturbance, lying disconformably on Unit IB.

HL 30 and HL 32: the lagoon bed and lunette

Trenches HL 30 and HL 32 were excavated by Professor R.V.S. Wright (Dept of Anthropology, University of Sydney), who visited Hawker Lagoon during our 1982 fieldwork season in search of faunal remains and other environmental evidence in the swamp sediments. Trench HL 30 is a 1 m^2 test pit in approximately the centre of the lagoon bed, excavated to a depth of 1.6 m and from there augered to a total depth of 3.9 m below the surface of the swamp bed. Throughout this depth the sediments were found to be hard clayey sand, grey in colour and devoid of stratigraphic differences. Other than an occasional fleck of charcoal, no organic substance was seen, nor was pollen found in samples submitted to Dr J. Dodson (University of NSW).

A line of auger holes extending from the swamp bed southward across the eastern end of the lunette helped to locate where lacustrine and terrestrial sediments intersected at the shoreline. At this point, Trench HL 32, a 1 m^2 test pit, was opened up to investigate possible stratigraphic relationships between artefacts and the lunette.

The trench was excavated to a depth of 1.0 m, then a small sondage was dug for a further 40 cm. The strata encountered were:

A	0–45 cm	loose orange sand becoming compact with depth — backed blade at 45 cm
B	45–65 cm	light grey sand containing a small flake at 65 cm
C	65–115 cm	hard red clayey sand — tiny carbonate flecks in top 4 cm — no artefact recovered
D	130+ cm	mottled yellow and grey clayey sand, intersecting with the grey clayey sand found in the swamp

From the outset, several of the strata seemed like those of HL1; stratum A corresponding to Unit IA, C to IIB, D to III, but B having no counterpart in HL1. Stratum B is interpreted as beach sand, partly because of its loose, coarse texture, but mainly because it is present only at the swamp margin, where sediments found while augering the swamp bed meet with Unit III. It diminishes in thickness

TABLE 8. HL1 radiocarbon dates.

Unit no.	Unit depth (cm)	Sample depth (cm)	Description	Age
IA	0-20	15-20	Scattered charcoal in loose sand	60 ± 50 (SUA: 2254)
IB	20-32	18-32	Scattered charcoal	5 100 ± 100 (SUA: 2253)
IIB	32-112	104-112	Fireplace in pit	14 770 ± 270 (SUA: 2131)
III	112+	112-120	Calcium Carbonate	2 950 ± 70 (ANU: 3353)

FIGURE 4. Plan of main excavation area of Hawker Lagoon.

and peters out, southward from the swamp, as auger holes revealed.

HL 40 and the north-western sector

Further to examine these putative relationships, HL 40, another 1 m^2 test pit was opened up on the lunette some 100 m SW of HL 32. At this point, deflation had not only unearthed a large number of artefacts but also revealed stratigraphy like that seen in HL1. Three strata were revealed:

0–12 cm	grey-brown compact sand containing flakes

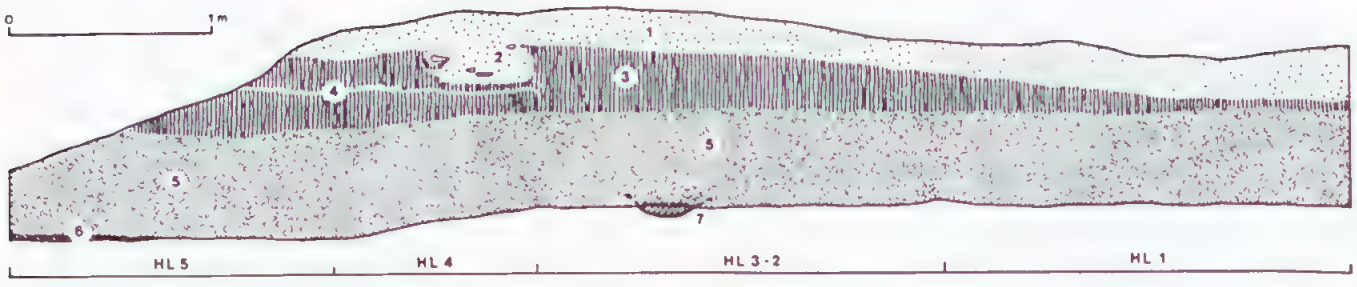

FIGURE 5. Stratigraphy of Trench HL1-5, Hawker Lagoon: 1. Loose orange sand (IA), 2. Disturbance (animal burrow), 3. Compact, grey-brown sand (IB), 4. Grey-brown clay band, 5. Hard red clayey sand (IIB), 6. Scattered charcoal, 7. Hearth in pit, dated by SUA: 2131.

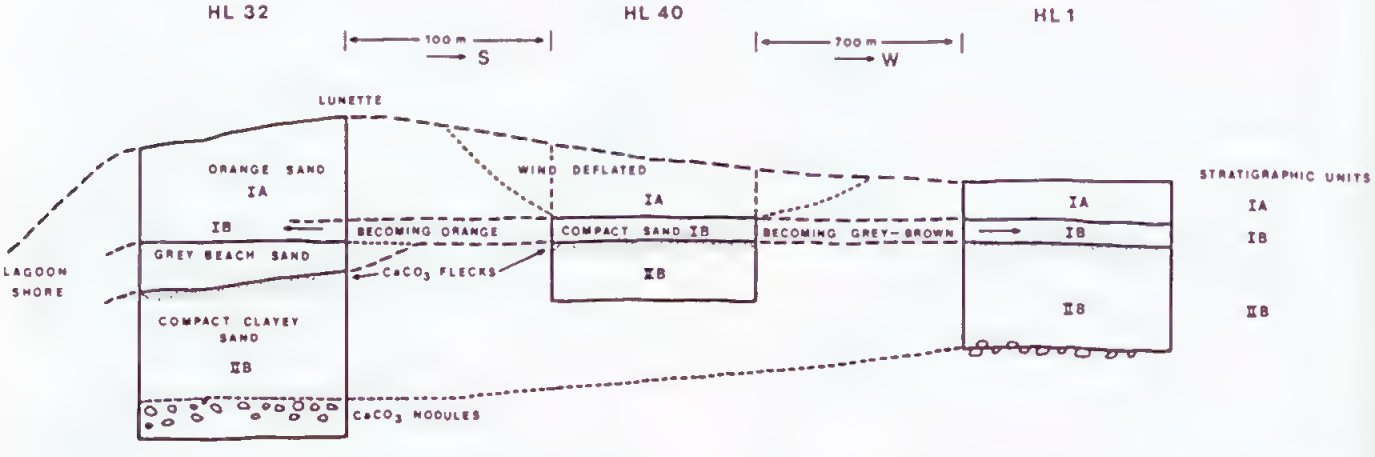

FIGURE 6. Composite section showing stratigraphic relationship between the three excavation trenches at Hawker Lagoon.

12-62 cm	hard red clayey sand with tiny carbonate flecks in top 4 cm and containing core tools
62+ cm	carbonate zone in mottled yellow and grey clayey sand

These are unmistakably the same strata as Units IB, IIB and III in trench HL1 some 700 m westward (Fig. 6). At HL40, Unit IA has been stripped away by deflation but is present just a few metres away on the surface of the lunette.

Having established this relationship, a line of closely spaced holes was augered between HL40 and HL32. These show that the top stratum (A) in HL32 is continuous with both Unit IA and Unit IB, even though no clear division can be seen in the HL32 section, while stratum C is continuous with Unit IIB in HL40 (Fig. 5).

HL TT and the south-western sector

HL TT is a section, exposed in a creek bank, 500 m south of HL1, showing the dune stratigraphy at this part of the site.

Unit No.	Unit depth (cm)	Description	Age
IA	0-22	Loose orange sand lying disconformably on IIA	Modern
IIA	22-57	Fairly compact red sand with large carbonate nodules in top 15 cm, lying disconformably on IIB	>8 380 ± 110 yBP (on carbonate)
IIB	57-76	Hard red clayey sand	
III	76+	Mottled yellow and grey clay with carbonate horizon	>13 930 ± 140 yBP (SUA-1 751) (on carbonate)

Because the eroded sediments above Unit II were discontinuous between HLTT and HL1, a complete stratigraphic section between the sites could not be examined. However, Units IA, IIB and III are com-

mon to both sites, and are clearly identical in terms of appearance, hardness, stratigraphic position and age. Unit IB is absent from HLTT, its stratigraphic position between IA and IIB being taken by IIA, a compact red sand with massive carbonate blocks in the top third of its thickness.

Regional stratigraphy and palaeoenvironments

From the morphology of the valley, it is apparent that all wind blown deposits overlie the tails of alluvial fans which mantle the middle and lower hill slopes. According to Williams (1973) such fans are part of the Pooraka Formation deposited between 40 000 and 30 000 years ago. However, there is no evidence for human occupation in the region at this time.

The earliest aeolian sedimentary unit encountered, Unit III, is also devoid of evidence for human presence. Lying between Unit IIB and the Pooraka Formation, Unit III must have been laid down some time between 30 000 and 15 000 years ago. Lying conformably below Unit IIB it appears to have still been accumulating at the end of this period. Thus, the upper sediments of Unit III may be part of widespread dune building of the arid phase which lasted altogether from 22 000 to 13 000 yBP (Bowler & Wasson 1983).

Unit IIB sands which contain the earliest evidence for human occupation, accumulated around 15 000 yBP, towards the end of the arid phase. Red in colour, IIB sands resemble those of the Edeowie dunes, some 45 km to the north, which also built up during the arid phase (Williams 1973). This was overlain by IIA, also a red sand but not cemented as tightly together as IIB. Towards the top of IIB a layer of massive tabular blocks of soil carbonate developed (Section HLTT) dated to older than *c.* 8 400 yBP, but possibly a local expression of the Motpena Palaeosol dated to *c.* 12 000 yBP (Williams 1973).

A phase of erosion followed, Unit IIA being stripped away completely in some areas (e.g. at HL1) and stripped down to the top the blocky carbonate palaeosol in others (e.g. at HLTT). In places where IIA had been stripped away the surface of IIB was weathered, then disconformably overlain by IB. We see no obvious reasons for this in the climatic models available. According to Williams (1973), from 16 000 to 12 000 yBP in the Flinders Range the climate was temperate with sufficient moisture to allow soil formation, while from 12 000 to 5 000 yBP conditions were generally more arid but rainfall was of great intensity causing high stream discharge rates. However, the broader climatic model of Bowler & Wasson (1983) shows the arid phase diminishing after 15 000 yBP but persisting until at least 13 000 yBP, after which conditions continued to improve as the moist phase of the Early Holocene was reached. Neither of these models offers an explanation for the weathering of Units IIA and IIB, which might result from peculiar local conditions caused perhaps by the site location in a narrow valley through which wind is channelled either from the north or the south.

The stratigraphy revealed in HLTT can be traced over most of the south-western sector of the Hawker swamp site complex. Because this sector had been cleared of its original woodland cover (mallee and native pine) much of it has been eroded deeply, usually to a level within the Unit IIB clayey sand. However enough remnants of overlying deposits are present to show the consistency of the stratigraphy across the sector.

Core tools, cores and largish flakes were found on and eroding from the exposed horizontal surface of Unit IIB but typical small tools are extremely rare in the south-western sector. Two core tools were found *in situ* within IIA while a number were found, as a lag deposit, on remnants of the exposed horizontal surface of IIA. Wind erosion seems to have ceased on reaching the horizon of massive carbonate nodules, which are harder than the sandy matrix of IIA. Later, the deposits were dissected deeply by numerous small streams carrying runoff to the valley floor, leaving flat topped columns of sediment capped by carbonate. While the nature of the sediments that have blown away cannot be ascertained beyond doubt, sections at the edge of the cleared land where upper deposits are still protected by mallee woodland, show that the IIA red sands continue for some 20 cm above the carbonate horizon. Because carbonate horizons form within, rather than on, a sedimentary unit, it seems likely that IIA red sand once lay above the carbonate horizon throughout this sector of the site.

Summing up the stratigraphic evidence

Table 9 brings together stratigraphic evidence from the various excavations and natural exposures discussed above. While not all strata are present in any one section, three (IA, IIB and III) are present throughout, and two others (IB and IIA) are closely dated enough to allow them to be placed in sequence.

The stone industries (Figs 7–10)

Surface evidence

The seemingly patchy distribution of artefacts shown on the site map (Fig. 3) results partly from lack of visibility where erosion has not occurred. This map shows also that while the Kartan industry is widespread, the small tool industry is confined almost entirely to areas where the two outflow channels emerge from the lagoon, where its distribution overlaps that of the Kartan.

Two controlled surface collections, designated HLA2 and HLSWI, were made in the cleared rectangular areas where the industry appeared to be

purely Kartan i.e. large core tools dominant but small tools entirely absent, while a third (HL7) was made at the western end of the lunette in a purely small tool area on recent sand (Unit IA) on the top of a dune.

Surface collection HL A2

This was collected near HL TT, in the SW sector of the site. Here the landscape is deeply etched with erosion channels, leaving less deeply eroded pedestals of sediment. Large core tools, cores and flakes were found both lying on the surface of these pedestals and partly embedded in the IIA red sand, some exposed in vertical sections being unquestionably *in situ*. All the exposed material was collected, and the following artefact types were identified:—

	N	%
Flake scraper	4	3.9
Core tool	20	19.6
Trimming flake	8	7.8
Core	19	18.6
Flake	51	50.0

Surface collection HL SW1

This was made in the extreme south-western corner of the site, where the eroded area finishes abruptly at an old fence line, beyond which the dunefield is well stabilised by its original thick cover of mallee. Along the eastern side of the fence line, where the site lies, the sediments have been eroded down uniformly to Unit III material, on which the artefacts now lie. This surfce is devoid both of vegetation and of naturally occurring stone. From the outset this area looked like a typical Kartan site on Kangaroo Island, with its predominance of large core tools among artefacts. However, it was seen to have an important advantage in that the industry is fully exposed on a clay base, unlike the Kangaroo Island sites where both vegetation and naturally shattered stone aroused suspicion of a bias in sampling (Lampert 1981).

A strip, 150 × 30 m, parallel to the fence was marked out and all stone collected. The following artefact types were identified:

TABLE 9. Correlation of dune stratigraphy at Hawker Lagoon.

Depositional Unit	Geological activity	Relationship with swamp	Age	Archaeological evidence
IA: loose, orange wind-blown sand	Depositional	Both units lie above beach of former high water level; water level now low	Late Holocene; present day land surface. Modern carbon date from bottom of unit shows post-depositional wind disturbance	Small tools including geometric microliths concentrated in small areas
IB: compact, grey-brown sand; present only in and near lunette	Depositional		Mid-to late Holocene; date of *c.* 5 100 yBP from bottom of unit	One small thumbnail scraper of microlithic character
Beach sand at swamp margin	Depositional	Water level high	Early-mid-Holocene	Microlith lying on, but not in, beach
None recognised	Erosional; weathering of IIB and IIA		Terminal Pleistocene?	None recognised; no lag of artefacts on IIB surface
IIA: red wind-blown sand present only in SW sector of site	Depositional		Greater than *c.* 8 400 yBP on carbonate horizon which could be Motpena Palaeosol (*c.* 12 000 yBP)	Kartan tools
IIB: hard, red wind-blown clayey sand	Depositional	Both units continue below beach of high water level	Pleistocene; date of *c.* 14 800 yBP from pit in unit	Kartan tools
III: mottled yellow and grey clayey sand with carbonate horizon	Depositional		Greater than *c.* 13 900 yBP on carbonate date, but must be older than IIB	None

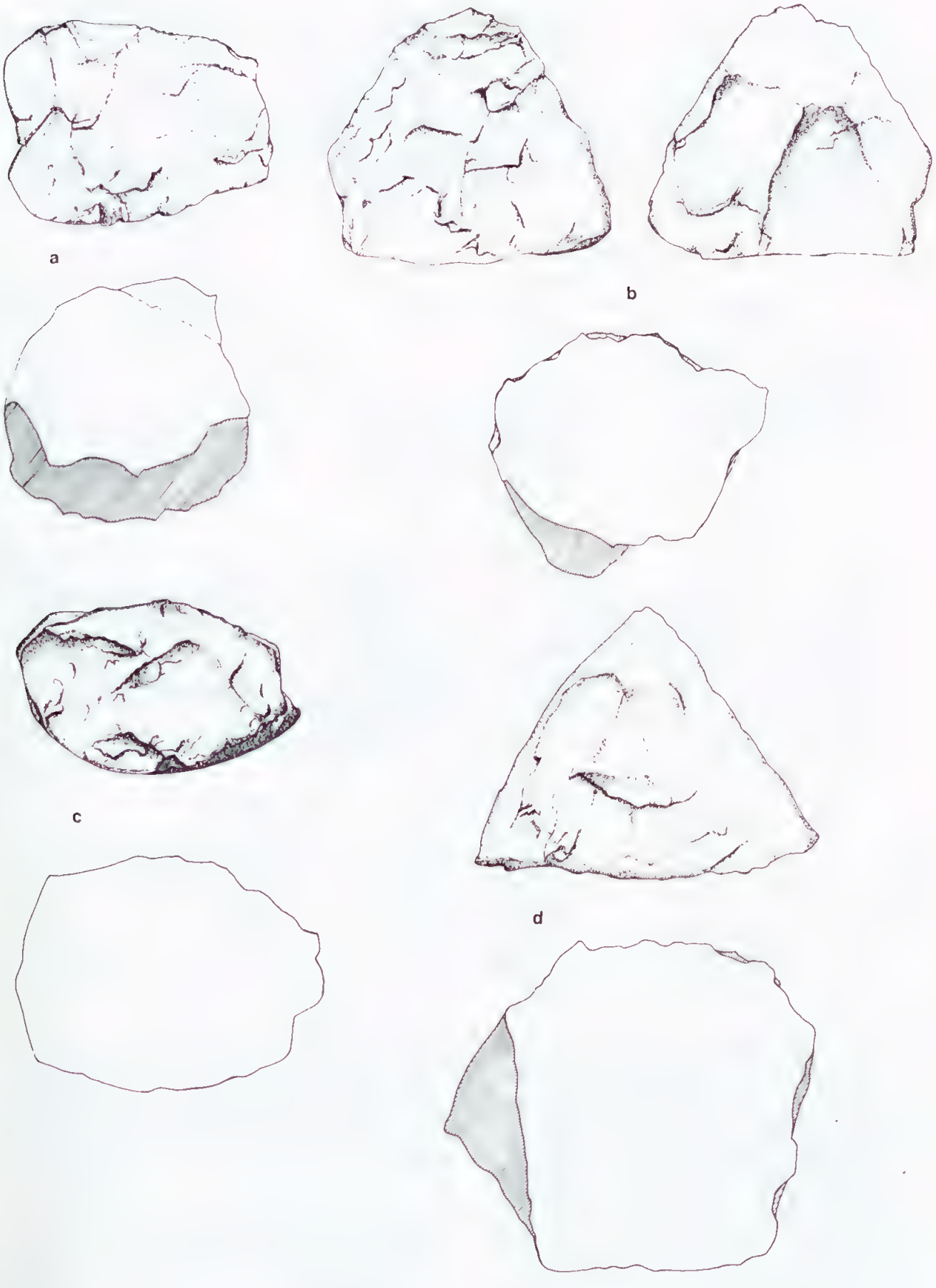

FIGURE 7. Core tools from Hawker Lagoon surface collections: a and b from HL2; c and d from SW1.

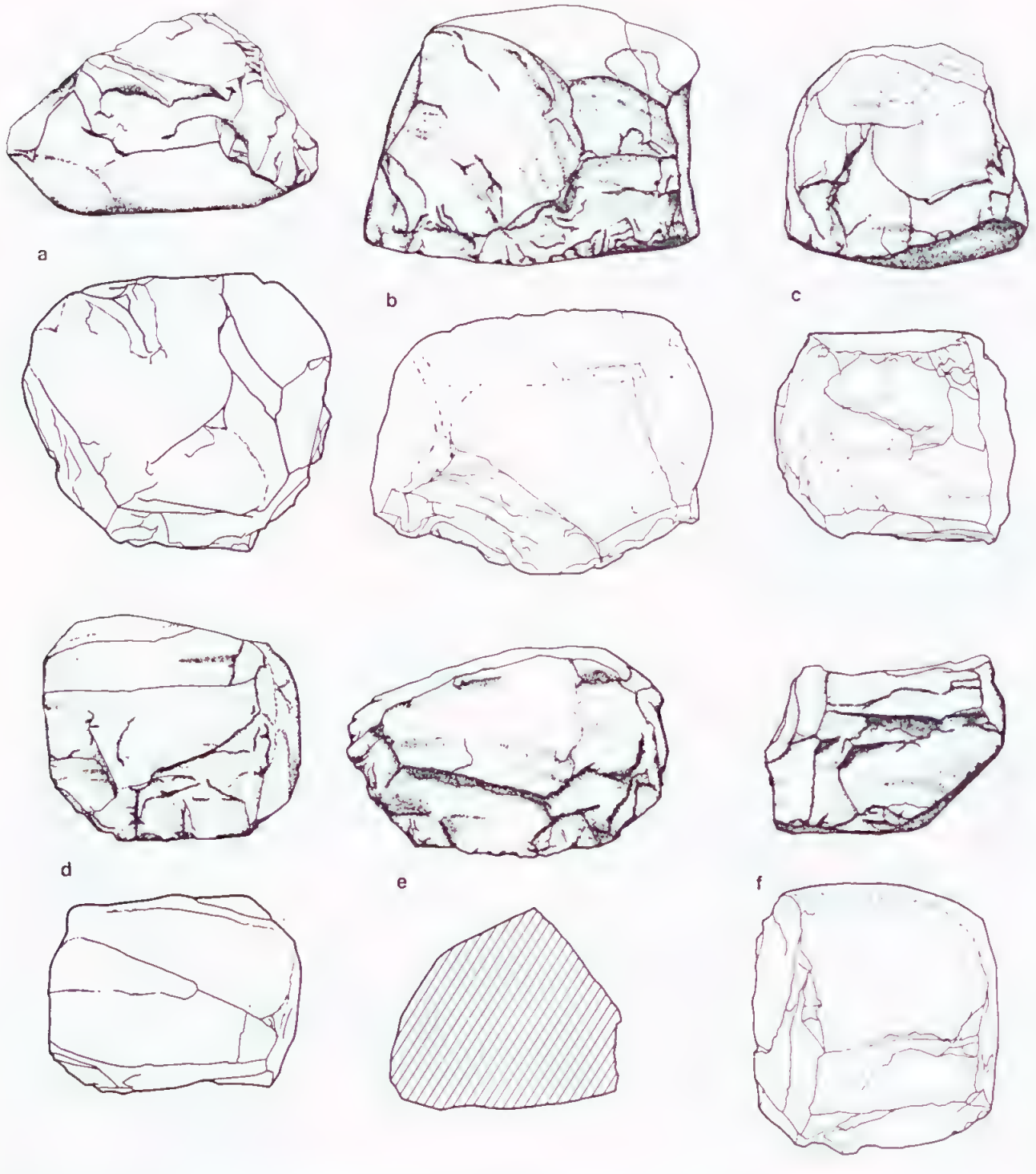

FIGURE 8. Core tools from Hawker Lagoon Unit IIB: a-f excavated from exposed surface (HLZ).

	N	%
Flake scraper	6	4.5
Core tool	31	23.5
Trimming flake	10	7.6
Core	19	14.4
Flake	66	50.0

Surface collection HL 7

This was made in a small (3 × 4 m) patch of IA sand some 40 m N. of the main excavation trench HLl. Wind had exposed a heavy concentration of small artefacts over a larger area, of which HL7 was seen as typical. The following artefacts were collected:

	N	%
Geometric microlith	6	0.2
Tumbnail scraper	3	0.1
Miscellaneous retouch	9	0.3
Bipolar core	1	0.1
Core	5	0.2
Flake	2570	99.1

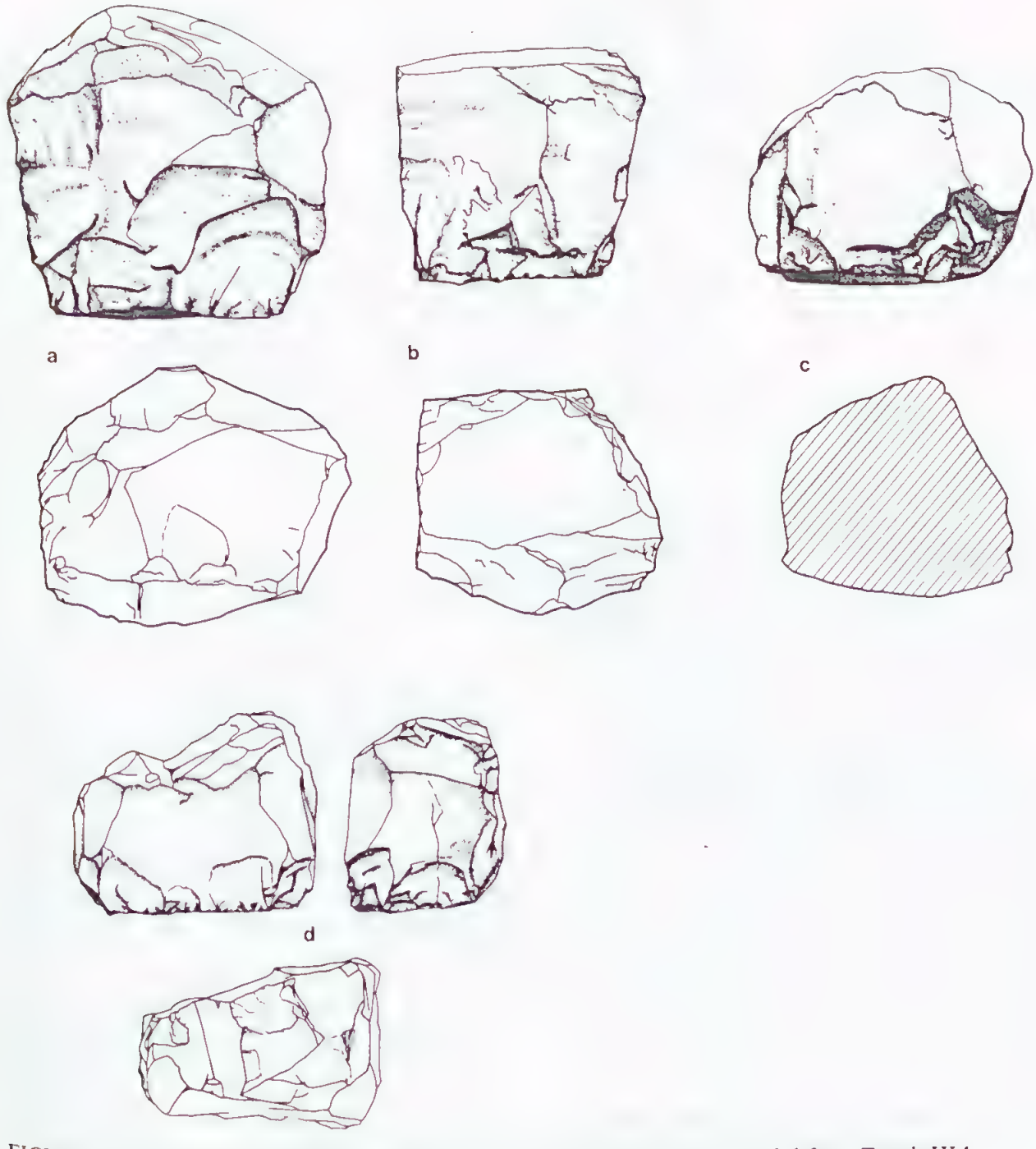

FIGURE 9. Core tools from Hawker Lagoon Unit IIB: a and b from HLZ; c and d from Trench HL1.

The preponderance of flakes over other artefacts is noteworthy, as is the small size of the material, most of which is 1-2 cm^2 and the largest piece, a flake, has a length of 5 cm. The 2 594 artefacts have a total weight of only 1 860 g.

Also of interest is the high density of artefacts: more than 200 m^2 at this one stage in the process of deflation. A year later, further erosion of IA sand had exposed a similar density of artefacts in this same small patch. This is typical of eroded patches in the north-west sector of the site suggesting that an immense amount of flaked stone lies buried within the nearby dunes.

Excavated samples from HL1 and HLZ

Table 10 shows the distribution of artefact types through the three sedimentary units in HL1, the main excavation trench. Unit IIB has been divided into three levels of equal depth to demonstrate that artefacts are embedded deeply enough in it to have been deposited during the unit's sedimentation. Also shown are the artefact types excavated from HLZ, the eroded surface of IIB sediments adjacent to HL1. The HLZ artefacts provide a larger sample from IIB than that given by HL1 alone.

The excavation of trench HL1 confirms that the two industrial traditions, recognised from surface

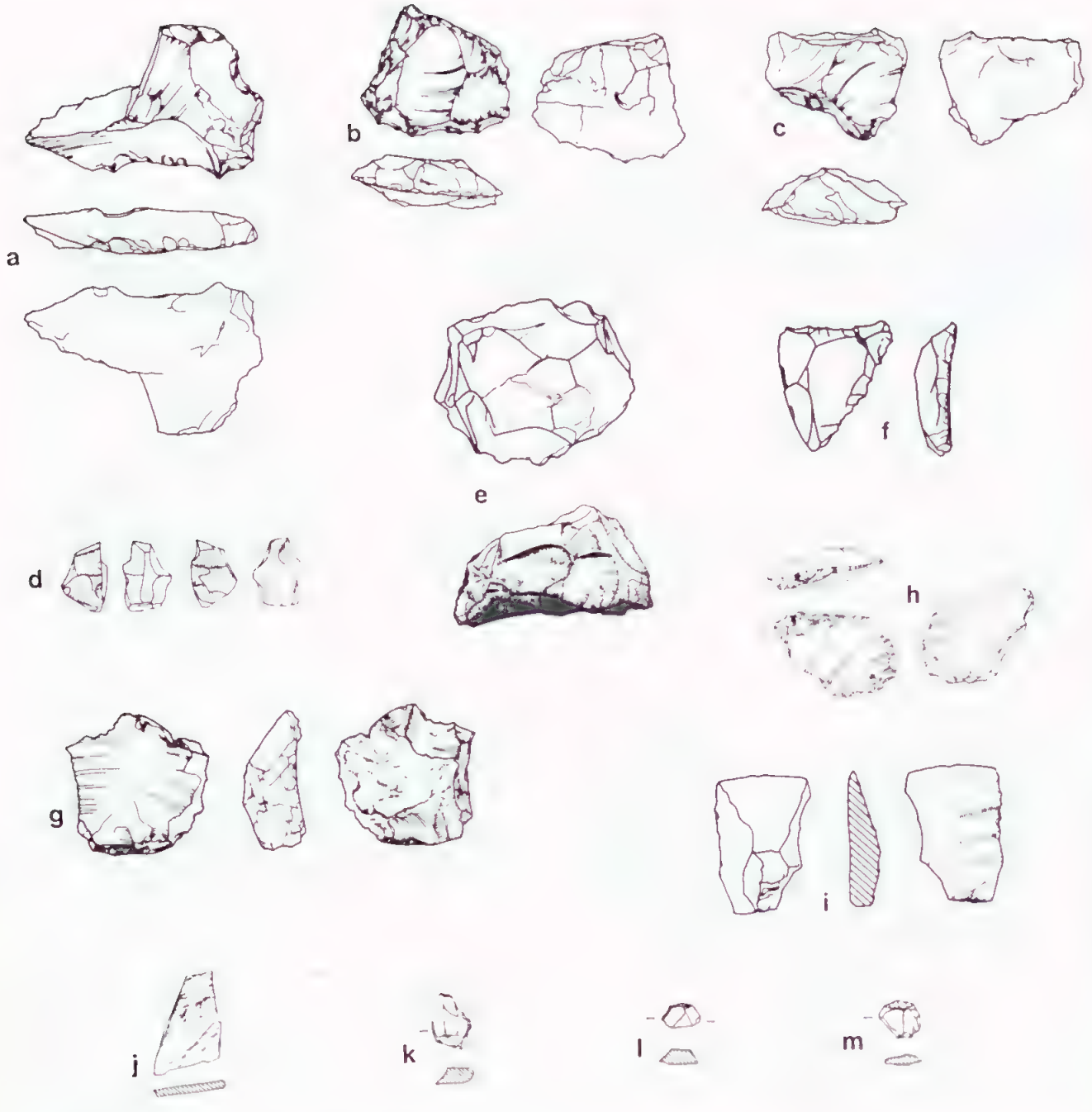

FIGURE 10. Artefacts from Hawker Lagoon Trench HL1: a to i, flake scrapers from Unit IIB; j, piece of reniform slate scraper from IA; k and l, microliths from IA; m, thumbnail scraper from IB.

evidence, were popular at different times. The earlier, dated to around 15 000 yBP, is characterised by core tools, trimming flakes and a high core to flake ratio (1:23). The later, dated from about 5 000 yBP, onward, is characterised by such typical small tools as geometric microliths, a pirri, thumbnail scrapers, a fragment of a reniform slate scraper and a low core to flake ratio (1:616).

Other changes occurred during the history of occupation. Sixteen of the core tools from IIB (HL1 and HLZ) are made on quartzite and one is on silcrete, whereas the microliths, pirri and thumbnail in IA and B are all made on silcrete. Flake scrapers, however, are made on silcrete and quartzite in roughly equal proportions throughout. This increasing popularity in the use of silcrete can be seen best in 'waste' flakes (Table 11), a change that is statistically significant. The size of artefacts changed, seen not only in the obvious change from core tools to small tools, but also in the decrease in size both of 'waste' flakes (Table 12) and of flake scrapers (Table 13) both changes being statistically highly significant.

Excavated samples from HL40

In this eroded area at the eastern end of the lunette only part of Unit IB and all of IIB were available for excavation, IA having been stripped away entirely. The following artefacts were recovered from Unit IIB:

TABLE 10. Hawker Lagoon: excavated artefacts from HL1 and HLZ.

HL1												HLZ					
Soil unit	Microlith	Pirri	Thumbnail	Bipolar core	Slate scraper	Scraper	Misc. retouch	Core tool	Trimming flake	Core	Flake	Soil unit	Scraper	Core tool	Trimming flake	Core	Flake
IA		1	2	1	1	5	9			1	1101						
IB	2					2	1			1	131						
IIB i						2				1	113						
IIB ii						5	6	2	4	12	259	IIB ii	4	11	5	16	60
IIB iii						11	13	4	10	22	420	IIB iii					

	N	%
Flakes	81	92.0
Cores	1	1.1
Core tools	3	3.4
Scrapers	2	2.3
Trimming flakes	1	1.1

This 1 m^2 test pit confirms that artefacts are *in situ*; that the strata are IIB overlain by IB, as found also at HL1; and that the IIB artefacts, in which core tools and flake scrapers predominate, conform with those from HL1.

Excavated samples from HL 32

A 1 m^2 test pit made to examine the stratigraphy at the lagoon shoreline, HL 32 revealed three strata described earlier. The following artefacts were recovered:

Units IA and IB combined (no stratigraphic division visible)	Flakes 434 Geometric microlith 1
Grey beach sand	Flakes 63 Thumbnail scraper 1
Unit IIB	No artefact found

The microlith was in the bottom 10 cm of units IA–IB and the thumbnail scraper was in the top 10 cm of the grey beach sand. It is possible that more recent material was trodden into the soft sand of the beach, indicating that the beach could have been formed before the advent of small tools. However this could not have been much earlier because the exposed loose sands of the beach would almost certainly have been either stripped away by deflation or a protective soil would have formed in its upper horizon. Given also the fact that the beach lies disconformably over Unit IIB, which shows the same upper zone of weathering here as it does below IB, it seems likely that the beach formed not long before IB i.e. at the mid-Holocene. This interpretation accords with the type of stone artefacts found in the beach. Not only is there a thumbnail scraper made on a section of a silcrete blade but there are many small flakes of silcrete, reminiscent more of the stone from upper levels (IB and IA) in HL1 than the lower level (IIB).

Typological relationships among core tools

To compare Hawker Lagoon core tools with those from Kangaroo Island, the same metrical observations were made (Lampert 1981). Samples provided by surface collections HLA2 and HLSW1, and by excavation of HL1/HLZ, were each compared with a sample of 76 block tools from Kangaroo Island (Fig. 11). As Tables 14 to 16 show, among 27 comparisons there are only two differences significant at the 0.05 level.

There are other similarities between the industries of the two regions:

1. With few exceptions, local stone of indifferent quality was used for core tools.
2. With the exception of HL1, where the sample is small, core tools predominate among formal tool types.
3. Given the number of finished tools, flakes and multidirectional cores are fewer than on non-Kartan sites.
4. Site areas are large with artefacts scattered fairly thinly.

Given this close correspondence with Kangaroo Island, the early industry at Hawker Lagoon must also be Kartan.

Summing up at Hawker Lagoon

Hawker Lagoon is a large open site with stone industries eroding from several strata in a lunette

TABLE 11. HL1 — distribution of unmodified flakes of silcrete and quartzite between upper and lower units.

Level	Silcrete	Quartzite	Total
IA, IB	50	50	100%
IIB	43	57	100%

TABLE 12. HL1 — distribution of unmodified flakes according to size between upper and lower units.

Level	1 cm	1.5–2 cm	2 cm	Total
IA, IB	66	31	3	100%
IIB	23	41	36	100%

and contiguous dunefield. Artefacts of the Kartan industry are present over a wide area, but small tools are confined to two localised patches where the lunette terminates near the sides of the valley and two channels carry overflow from the swamp downstream. The Kartan tools are provenanced to two lower horizons, IIB and IIA, dated to 14 770 ± 270 yBP and older than 8 380 ± 110 yBP, respectively; the small tools to two upper horizons, IB and IA, dating back to 5 100 ± 100 yBP, and possibly to beach sands stratigraphically between IIA and IIB. Further excavation is planned to elucidate the late Holocene stratigraphy, not only at the swamp shore, but also near the location of Trench HL1 where the upper horizons (IA and IB) suffered post-occupational wind disturbance.

Over much of the site, Unit IIA is not present, presumably stripped away by the same climatic event that weathered the surface of IIB. However, no particular reason for this event, between *c.* 15 000 and 5 000 yBP, can be identified in the broad palaeoclimatic history of the region, suggesting it may have local rather than regional causes.

The presence of a beach, stratigraphically between IIA and IB, shows that a stand of high water also occurred in the 15 000–5 000 yBP period. Because the weathered surface of IIB continues below the beach, the phase of erosion preceded that of high water. The wetter local conditions that must have caused the stand of high water are thought to be part of the early Holocene wet period evidenced for southern Australia generally, suggesting a terminal Pleistocene date for the phase of erosion.

The Region in the Context of Australian Prehistory

The Kartan industry

Description of the Kartan industry

Because some of the main conclusions reached in this report depend upon proper recognition of

TABLE 13. HL1, HLZ flake scrapers comparison between upper (IA, IB) and lower (IIB) depositional units. . S.D. = standard deviation, N = sample size.

Attribute	Significance Level NS	.05	.01	.001	Mean (S.D.) IA, IB (N = 8)	Mean (S.D.) IIB (N = 16)
Length				+	24.5 (5.2)	58.1 (20.8)
Breadth				+	22.0 (6.2)	47.5 (14.0)
Height				+	8.1 (1.2)	22.6 (10.3)
Breadth/length	+				123.8 (20.1)	128.4 (35.4)
Height/breadth	+				276.9 (76.4)	247.3 (111.3)
Retouch length			+		24.5 (7.5)	77.3 (51.7)
Retouch percent	+				34.3 (14.6)	43.1 (22.0)
Retouch angle	+				64.8 (3.6)	70.0 (13.4)
Weight		+			8.3 (2.1)	87.9 (81.8)

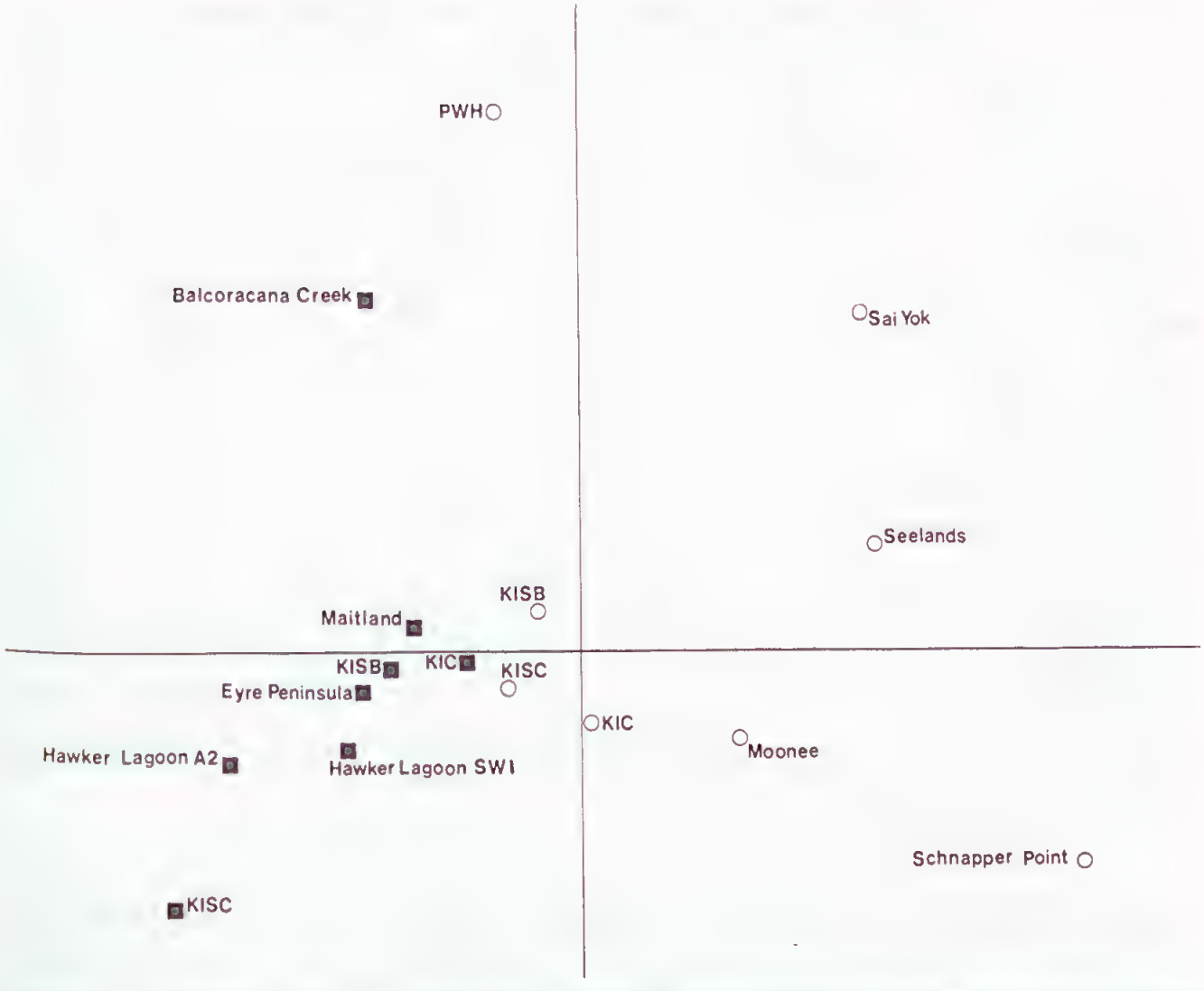

FIGURE 11. Discriminant function analysis comparing Hawker Lagoon and Balcoracana Creek core tools with those from elsewhere (data from all sites outside the Flinders Ranges are mentioned in Lampert 1981: Fig. 36). Note that Hawker Lagoon clusters with other South Australian Kartan sites while Balcoracana Creek is closer to Pigs Water Hole (PWH). KI = Kangaroo Island.

the Kartan we put forward the following criteria, taken from Lampert (1981, 1983):

1. The Kartan is found on Kangaroo Island and in nearby parts of mainland South Australia, mainly on open sites near fresh water.
2. The dominant artefact in Kartan assemblages is a large core tool made on either a pebble or block of quarried stone in accordance with the availability of local stone.
3. Kartan core tools have metrical-statistical characteristics, described by both Matthews (1966) and Lampert (1981), which distinguish them from core tools in all other known industries from the Australian-South East Asian region.
4. Another characteristic that appears unique to Kartan assemblages is the rarity of flakes, flake tools and cores, compared with core tools.
5. Kartan core tools are unifacially flaked from a flattish base, producing a working edge that extends, on average, around half the base perimeter.
6. With use and sharpening, the edge becomes steeper and extends further around the perimeter, leading eventually to the classic horsehoof core on which the edge is too steeply overhung for the artefact to be functional as a tool.

Since this description was published, other information has emerged. From his excavation of a 7 000 year old occupation level at the Cape du Couedic rockshelter on Kangaroo Island, Draper (1987) claims to have recovered Kartan tools, and believes that the Kartan owes much of its character to the use of a particular reduction sequence, suited to the kind of stone. For different raw material, another technology was favoured. At the very least, this view provides an alternative hypothesis to those explored by Lampert (1981) in seeking to explain the spatial separation of Kartan from most other sites on Kangaroo Island. Characterised by 'two large pebble choppers, a couple of small ones (comparable to . . . examples from Pigs Water Hole

TABLE 14. Core tools from surface site HLA2 compared with KI block tools. S.D. = standard deviation, N = sample size.

Attribute	Significance Level NS	.05	.01	.001	Mean (S.D.) HLA2 (N = 20)	Mean (S.D.) KI (N = 76)
Length	+				107.5 (16.7)	106.4 (20.2)
Breadth	+				90.8 (14.7)	85.4 (16.6)
Height	+				73.0 (20.5)	65.0 (17.8)
Breadth/length	+				118.6 (13.4)	126.9 (22.4)
Height/breadth	+				132.4 (30.8)	144.1 (56.0)
Retouch length	+				184.2 (64.3)	156.7 (71.4)
Retouch percent	+				57.2 (16.5)	51.0 (21.8)
Retouch angle	+				84.9 (4.6)	84.0 (8.7)
Weight	+				927.4 (331.7)	881.7 (451.4)

TABLE 15. Core tools from surface site HLSW1 compared with KI block tools. S.D. = standard deviation, N = sample size.

Attribute	Significance Level NS	.05	.01	.001	Mean (S.D.) HL (N = 31)	Mean (S.D.) KI (N = 76)
Length	+				109.6 (13.5)	106.4 (20.2)
Breadth	+				90.3 (15.0)	85.4 (16.6)
Height	+				65.8 (16.0)	65.0 (17.8)
Breadth/length	+				122.8 (16.2)	126.9 (22.4)
Height/breadth	+				145.3 (45.6)	144.1 (56.0)
Retouch length	+				130.0 (49.1)	156.7 (71.4)
Retouch percent		+			40.1 (12.2)	51.0 (21.8)
Retouch angle	+				82.8 (6.3)	84.0 (8.7)
Weight	+				846.9 (350.8)	881.7 (451.4)

TABLE 16. HL excavated sample compared with KI block tools. S.D. = standard deviation, N = sample size.

Attribute	Significance Level NS	.05	.01	.001	Mean (S.D.) HL (N = 17)	Mean (S.D.) KI (N = 76)
Length	+				97.6 (16.9)	106.4 (20.2)
Breadth	+				80.8 (16.2)	85.4 (16.6)
Height	+				64.4 (14.3)	65.0 (17.8)
Breadth/length	+				122.6 (12.5)	126.9 (22.4)
Height/breadth	+				125.6 (12.0)	144.1 (56.0)
Retouch length	+				149.8 (75.9)	156.7 (71.4)
Retouch percent	+				57.1 (24.5)	51.0 (21.8)
Retouch angle		+			89.1 (2.4)	54.0 (8.7)
Weight	+				714.7 (400.6)	881.7 (451.4)

. . .)' and 'hundreds of quartzite flakes' (Draper 1987: 5), the Cape du Couedic assemblage appears to have greater similarity with the Pigs Water Hole site (Lampert 1981: 81-96), for which, like Cape du Couedic, an early Holocene age is indicated, than with the more usual range of Kartan sites. However, the presence of large pebble choppers within the assemblage does support Draper's suggestion (1987: 6) that Cape du Couedic is the 'missing link' in site variation, indicating a closer relationship between Pigs Water Hole and Kartan sites than Lampert's research suggests.

Research at the Lime Springs site, in inland northern New South Wales, has revealed an industry featuring horsehoof cores and large flake scrapers, termed Kartan by the authors (Gorecki *et al.* 1984), in the upper levels of a deposit dating back some 19 000 years. Because this industry has not been fully described by the authors its relationship with the Kartan from South Australia cannot be determined. However, a metrical-statistical comparison between core tools from South Australia and coastal northern New South Wales (Lampert 1981) shows no close relationship; instead it reinforces a view of the Kartan as a regional industry confined to South Australia. Other writers question the status of the horsehoof core as a tool. Both Kamminga (1982) from the absence of use wear, and Flenniken & White (1985) from the steepness of edge angle, conclude that most horsehoofs are simply cores rather than core tools, a view not greatly different from that of Lampert (1981: 65) who sees the horsehoof core as 'the worked out remnant of a tool' rather than a functional tool *per se*.

The geographical range of the Kartan

Previous typological studies (Matthews 1965, 1966; Lampert 1981) establish the Kartan as a regional industry within the Australian core tool and scraper tradition, confined to Kangaroo Island and the three nearby mainland peninsulas, Fleurieu, York and Eyre, with the Wakefield River as the most northerly site recognised. That view is changed by the present study which confirms reports by Cooper (1968) of Kartan sites in the northern Flinders Ranges. However, no Kartan site was found while reconnoitring surrounding desert areas, ranging as far north as Innamincka, Birdsville and Oodnadatta (Hughes & Lampert 1980, 1985; Lampert 1985); nor have Kartan sites been reported from coast and hinterland to the west and east of the three peninsulas. On present evidence then, the Kartan extends from a clearly defined sector of the South Australian coast, through the Mount Lofty Range, and the southern and northern Flinders Ranges, but is absent from surrounding regions. As Lampert (1981) shows, Kartan sites are invariably in hilly country, near either a stream or lagoon, and usually placed on the lower slope of a hill, often with a northerly aspect. Sites in the Flinders Ranges conform to this locational pattern, both Mount Chambers and Mooroowie Well being on slopes near streams, while most Hawker Lagoon Kartan tools lie on the lower slopes of the Yappalla Range.

The Kartan industry has an upland distribution, ranging from humid coastline in the south to desert ranges in the north. Such a distribution indicates cultural unity through the long chain of ranges, despite climatic diversity. Recent patterns of Aboriginal culture show unity within drainage basins, but division along watersheds, such as ranges (Peterson 1976). However, the ranges in question are wide enough to have been a cultural province themselves. Indeed, present day Aboriginal inhabitants of the northern ranges, who were interviewed by Lampert, distinguish between 'rock' (or hill) people, such as the Adnyamathanha, and 'salt water' (inland salt lake) people like the Arabana.

Age of the Kartan

From its presence on Kangaroo Island, an antiquity greater than the flooding of the land bridge that had joined the island to the mainland (*c.* 9 500 yBP) is inferred (Tindale 1957, Cooper 1960, Lampert 1981). While the Hawker Lagoon date of *c.* 15 000 yBP confirms that the Kartan has Pleistocene origins, recent excavations at Cape du Couedic, Kangaroo Island, suggest that Kartan tools were still in use at some sites as recent as *c.* 7 000 yBP (Draper 1987). This modifies the view of Lampert (1981), deduced from the absence of the industry at several dated sites, that Kartan tools had gone out of use at least before 11 000 yBP, and possibly before 16 000 yBP.

Later core tool assemblages

The Lake Frome sites at Balcoracana Creek and Big John Creek, the Kangaroo Island site at Pigs Water Hole, and possibly Cape du Couedic, have several features in common, including an early Holocene age. Like Kartan sites, core tools predominate in the assemblages, but the tools are smaller and have working edges of different orientation. These differences, though statistically significant, are not as great as those between either group and local assemblages of the small tool tradition; nor is there a great time difference between the two groups judging from the dates of Hawker Lagoon and Balcoracana Creek. Possibly we are looking at a 'sub-Kartan' industry, which has developed out of the Kartan and retained some of its features.

Movement of people

At Hawker Lagoon the bulk of the archaeological evidence is concentrated within two broad phases: (i) an early phase around 15 000 yBP with Kartan artefacts, (ii) a late phase beginning about 5 000 years ago and continuing possibly until the late 19th century. Stratigraphically these phases are represented by units IIA–IIB and IA–IB, respectively, but in the three excavated areas IIA is not presented. The disconformity between IIB and IA represents a 10 000 year gap in the site's despositional and human history. If the site had been popular during that time artefacts should appear as a lag on the weathered IIB surface, but this is not the case. The possibility of artefacts having shifted by natural means at the site is currently being investigated by taphonomic studies. Conducted by Dr J.P. White (University of Sydney) and the authors, these studies involve annual observation over 10 years. Preliminary results from fieldwork in 1987 indicate that small, flattish flakes are moved easily by strong gusts of wind, some being blown as much as 4 m uphill on an eroded dune face, suggesting that the 'industry' in Unit IA, Trench HL1, which consists almost entirely of flakes of this kind, is in fact a wind sorted component of an industry.

Meanwhile we assume that a whole industry, including its larger elements, could not have been swept away entirely by runoff, wind or other natural force, and this part of the site was not occupied to an archaeologically visible degree during those years. Why this should have occurred during the early Holocene when conditions were moist and the lagoon brimming with fresh water seems paradoxical.

In answer we propose that moister conditions allowed people to spread themselves more widely, occupying regions that had been inhospitably arid. Under this explanation it comes as no surprise to learn that the main phase of occupation of the shores of Lake Frome was the early Holocene. With moist conditions general, the more reliable water sources such as Hawker Lagoon were no longer a focus.

The early occupation of the arid zone

Recent Aborigines in arid and semi-arid regions have a pattern of movement that takes maximum advantage of the availability of water and other resources. During dry times they fall back on reliable sources of water such as streams (Allen 1974) or desert uplands (Peterson & Long 1986), but after rain move out across the landscape exploiting ephemeral water sources such as pans, soaks and streams, and with them a wider range and greater abundance of foods. For the Flinders Ranges, a senior Adnyamathanha man told Lampert that his people were based in the Ranges but sometimes 'in a good season' they made brief forays as far as the shores of Lake Frome. One of the places visited was Eudli Wagloona, on the south-eastern shore of Lake Frome, where Lampert noted an extremely sparse scatter of stone flakes (1 per 50 m^2) around an ephemeral waterhole.

On a much longer timescale, this pattern of movement is the same as that envisaged in the more distant past, people based in the better watered

Ranges within a dry phase moving out to the shores of Lake Frome as conditions became wetter during the early Holocene.

Hawker Lagoon shares a number of similarities with Puritjarra, a rock shelter in the Cleland Hills of central Australia in which occupation dates back to *c.* 22 000 yBP and appears to be continuous through the last glacial maximum until at least 12 000 yBP (Smith 1987). Both sites not only confirm a Pleistocene age for human settlement of the arid interior but are in desert uplands. At both sites the deposits are sandy and devoid of such direct evidence for past environments as pollen or plant and animal remains. However, the desert uplands in which the sites lie fringe the Lake Eyre Basin where stratified sediments spanning much of the Pleistocene and Holocene contain a wide variety of environmental evidence. This enormous basin, draining about one million square kilometres, is the focus of future arid zone prehistoric studies, both by the authors and by other researchers (Lampert in press, Lampert *et al.* in prep.).

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This project would not have been possible without the help given by local landholders and other residents, notably Mrs E. Jarvis and Mr T. Jarvis, of 'Pine Flat', Mr F. Teague and family of Hawker, Mr and Mrs B. Powell of Quorn, Mr J. McEntee of 'Erudina', Mr T. Rieck of 'Merty Merty', Mr A. Wilson of 'Frome Downs' and Mr B. Reynolds of 'Yankanina'. We were encouraged and guided throughout by Aboriginal people of the local Adnyamathanha community, particularly by the late Mr J. McKenzie, and by Mr C. Coulthard, Mrs P. McKenzie, Miss C. Wilton, Mr R. Wilton and Mr D. Coulthard.

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A number of scientists contributed specialist knowledge: Dr R. Wasson (C.S.I.R.O.) and Dr J. Ash (Australian National University) examined dune stratigraphy; Professor R.V.S. Wright (University of Sydney) and Dr M. Sullivan (University of Papua New Guinea) worked on stratigraphic problems at Hawker Lagoon, on which Dr R. Sprigg ('Arkaroola') also gave advice; Dr J. Dodson (University of New South Wales) sought pollen in soil samples; Dr J. Bowler (Museum of Victoria) gave information on landforms and sites at Lake Frome; Mr M. Smith (Museum of the Northern Territory), Professor Jim Allen (La Trobe University) and Dr Harry Lourandos commented on a draft of this paper. Mr S. Florek and Ms A. Richards (both Australian Museum) drafted most of the final drawings.

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NOTES ON A WOODEN IMPLEMENT TYPE FROM NORTH-EASTERN ARNHEM LAND

M. PICKERING & J. DEVITT

Pickering, M. & Devitt, J. 1988. Notes on a wooden implement type from north-eastern Arnhem Land. *Rec. S. Aust. Mus.* 22(2): 169-171.

This paper presents data on a wooden implement found at a site in north-eastern Arnhem Land and discusses briefly its significance for archaeological research elsewhere.

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This paper illustrates, describes, and discusses a particular type of artefact from north-eastern Arnhem Land, northern Australia. Consideration of these artefacts helps illustrate the importance of functional, as opposed to morphological, observations in the typological classification of artefacts.

The implements were collected during fieldwork in the Nhulunbuy area of north-eastern Arnhem Land in late 1986. They were recovered from sites on a small island which is connected to the mainland by a 300 m permanent exposed sandbar. This island is basically a granitic rocky outcrop consolidated by sandy soils and coastal scrub vegetation. It is edged by a rocky boulder shore, often steep in places. The island is a popular visiting spot for Yulngu and white residents of Nhulunbuy.

During a casual walk around the island, easily accomplished in two hours, the authors' attention was drawn to the numerous scatters of rock oyster shells (*Saccostrea cucullata*). These scatters were, characteristically, usually within 20 m of the water and on bare flat rock surfaces. The shells were often burnt and/or associated with charcoal and burnt sticks.

No sites were observed which had any stratigraphic depth or, indeed, potential for formation of deposit. The scatters were usually within the zone subject to wind, wave and rain action, particularly in the summer wet season. Even before we discussed these shell scatters with local informants it was obvious that they were the product of shellfish collecting for food. They reflect single transient occupation, such as a 'dinner camp'. A small permanent Yulngu community resides approximately 2 km away. The island falls within the traditional country of the Rirratjingu clan group.

The Implements

Two of the shell scatters were subjected to closer examination. These contained eight wooden implements in definite association with the shells and charcoal. Figure 1 provides a field map of the site from which these artefacts were collected. This site is typical of the location and condition of these sites. A tyre lever was seen in a crevice. This may have been used for removing the oysters from the rocks.

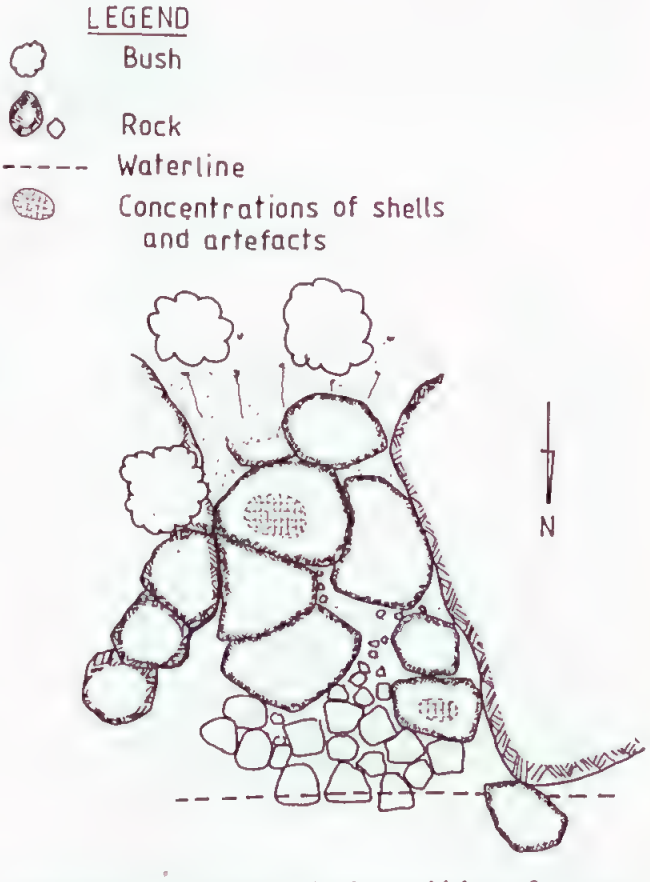

FIGURE 1. Field map of site from which artefacts were obtained. Scale approximately 1 cm = 2 m. Compiled from field sketch.

A Yulngu informant (Warramirri clan) identified these artefacts as **Birngal** and described their functions as being for picking shellfish out of their shells or for the removal and/or cleaning of small skin

eruptions (caused by parasitic infection or biological actions e.g. pimples). They could be produced at any time.

Meehan (1982: 101, 102, 110) reports the similar use of wire and bone points to break open the shells and remove the flesh of oysters, (*Crassostrea amasa*) amongst the Anbarra of north-central Arnhem Land.

Also on the site were several tops of soft drink cans, though no cans were found. The informant explained that the cans were sometimes used to carry oysters back to camps, the tops being removed and discarded to make the container.

The implements are illustrated in Fig. 2 and are best described according to their level of modification.

Implement 4 is simply a twig from which the bark has been peeled to make a point which has subsequently been rounded through use. Implement 1 is a split twig, triangular in cross-section, retaining some bark on the outer surface. The tip is modified, possibly through grinding. Implements 5, 6 and 8 are similar to 1 and 4 except the tips have been shaped through cutting. They retain some remnant cut facets.

Artefact 2 is a single-pointed implement with a modified butt. The point is smoothly shaped with some remnant cut marks almost obscured through rounding, probably by use. The shaft appears to have been worked smooth. The butt is abrupt with clear cut marks and facets. Implement 7 is bi-pointed. The shaft shows clear faceting through cutting, though use has rounded the edges. Both points are rounded. The implement has a low sheen, presumably through being held. Implement 3 is a highly modified bi-point. It has remnant facets along its length showing its manufacture by cutting. Use has, however, tended to round and obscure the edges of these facets, which do not show up in the illustration except in cross section.

Discussion

With the exception of implement 4, all implements were made with a steel knife. In some examples the direct evidence of this, the cut marks and faceting, have been obscured through use. Such use-wear is probably quick in forming given the hard abrasive nature of the oysters' homes.

Sites such as the one we have described and their associated artefacts are unlikely to last long in the archaeological record. The action of wind, waves and other activity would quickly disperse all site contents. Even where conditions were more stable, and formation of deposit likely to occur, the wood-

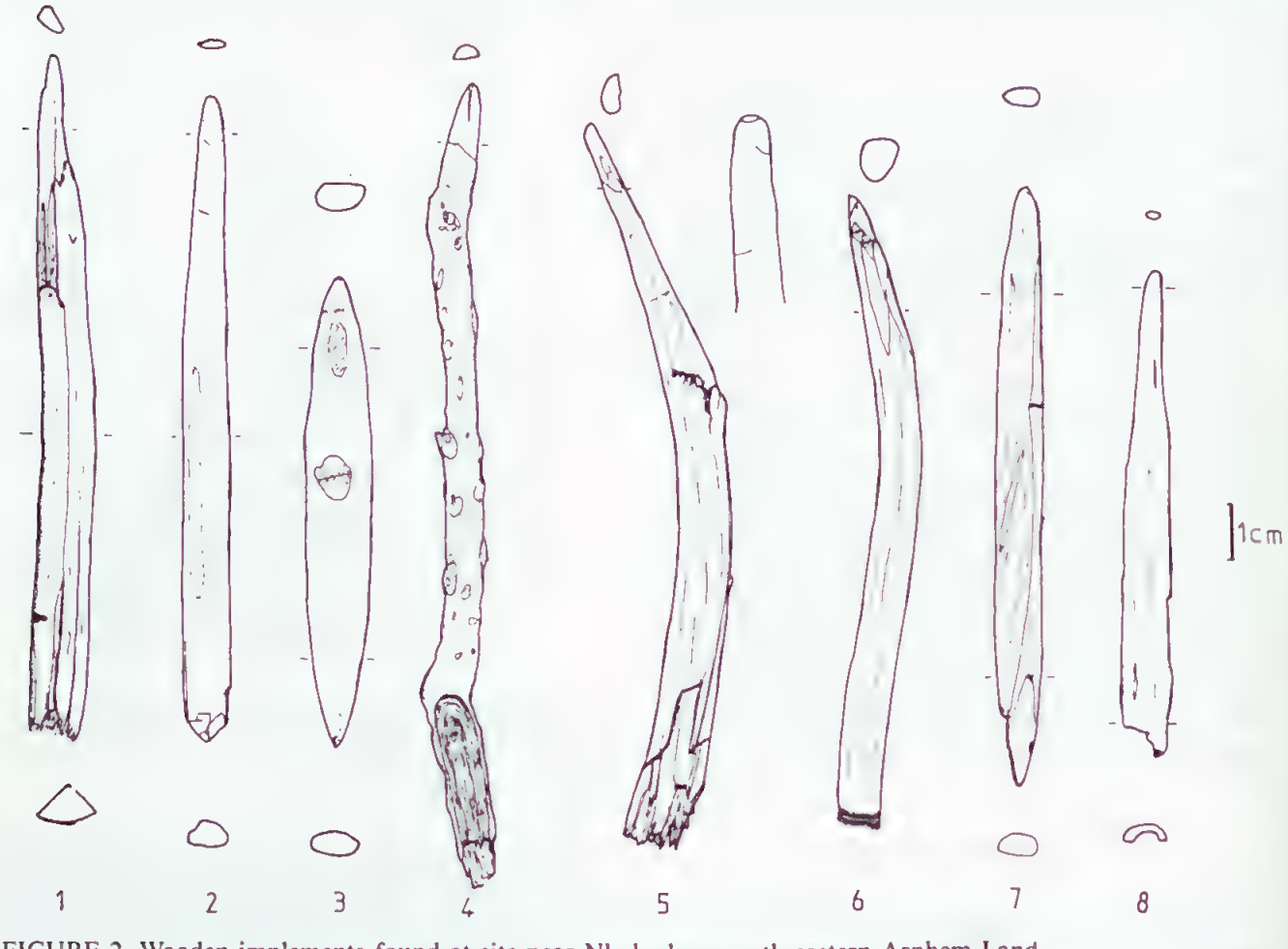

FIGURE 2. Wooden implements found at site near Nhulunbuy, north-eastern Arnhem Land.

en artefacts would rapidly decay, or their technological attributes erode to a degree where status as implements is concealed.

The implements also illustrate a question of typology. Put simply, the artefacts vary greatly in their form but not in their functions. Conventional typologies, based on observation of technological attributes and unsupplemented by ethnographic data, would obscure this functional unity.

The description of these implements also has implications for interpretation of archaeological remains from elsewhere in Australia. One author (Pickering 1979) has suggested that bone artefacts, frequently recovered from south-eastern Australian coastal sites, may have been complemented by a similar range of wooden points which had decayed and so were not represented archaeologically. Fresh wood and fresh bone share similar structural characteristics in the form of high tensile and compressive strength, which makes them sometimes interchangeable. The morphological range of the wooden artefacts described here is analogous to examples of bone points found throughout coastal Australia. It is, therefore, not unreasonable to suggest that similar artefacts would have been utilised by other groups which exploited shellfish.

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YANYUWA CANOE MAKING

R.M. BAKER

BAKER, R.M. 1988. Yanyuwa canoe making. *Rec. S. Aust. Mus.* 22(2): 173–188.

This paper describes the construction of a dugout canoe near Borroloola in the Northern Territory in 1987. The history of canoe making and use in the area is also documented using written and oral records. The taping of information about objects collected by Museums has often been neglected. This paper illustrates the value of collecting such oral accounts both in documenting the process of manufacture and in revealing the wider cultural context of that object. When such information is ignored, there is the danger of viewing the collected object out of its social and historical context.

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Canoe Construction

In 1987, as part of research on the contact history of the Yanyuwa who live in the Borroloola area of the Northern Territory (Fig. 1), I documented the construction of a dugout canoe which had been commissioned by the Australian National Maritime Museum in Sydney. This article presents a description of this construction along with background

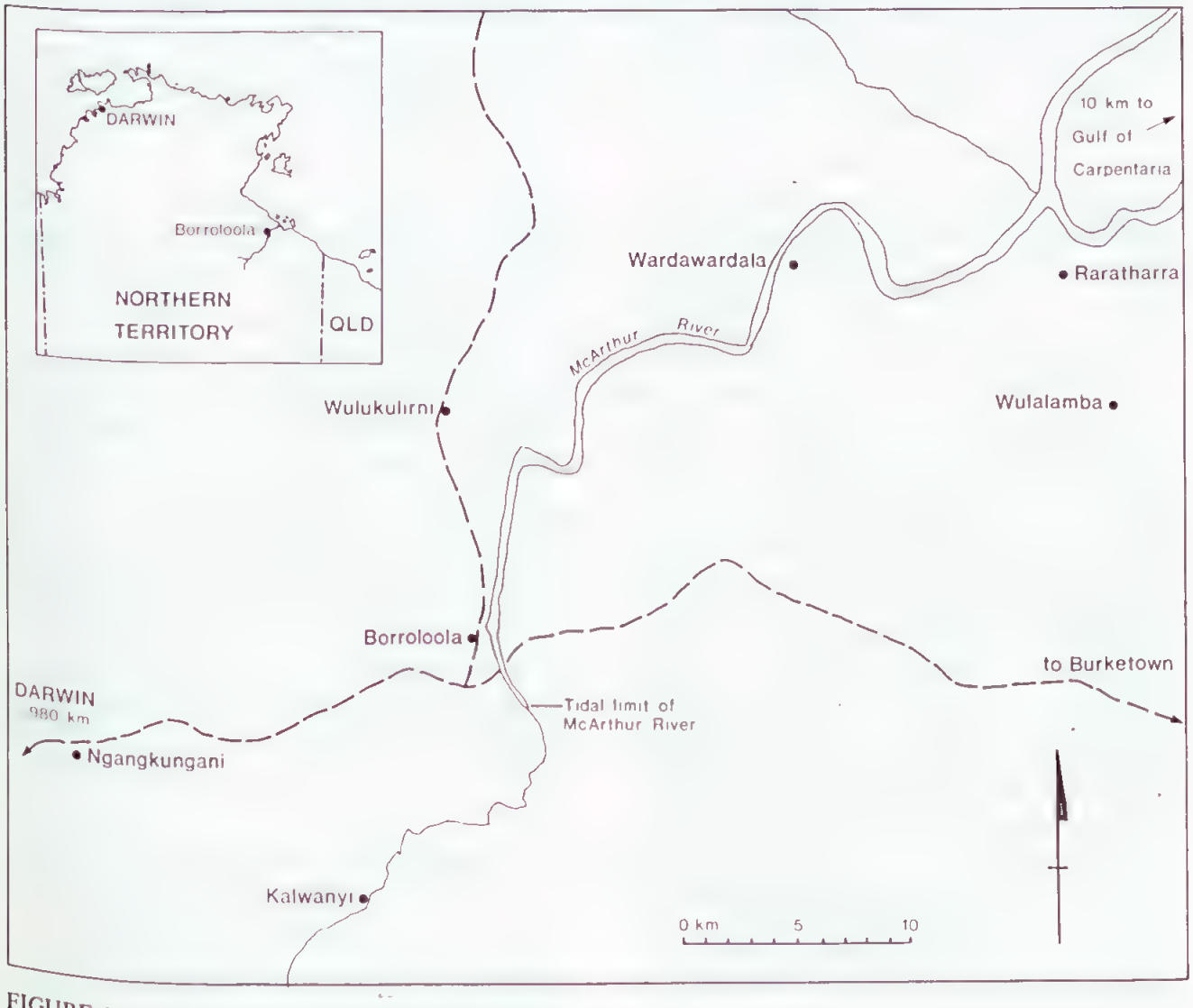

FIGURE 1. Borroloola area and surrounding region.

information on the history of Yanyuwa canoe making and use.[1]

The canoe was constructed by Annie Karrakayn, her husband Isaac Walayungkuma and Ida Ninanga. Karrakayn is approximately 55 years in age, Walayungkuma 65 and Ninanga 70 (see Fig. 2). Ninanga had previously made a dugout canoe which was purchased by the Museum of Australia in 1986. Isaac Walayungkuma is an experienced canoe maker who worked on canoes when they were still constructed for use in the area. He has also made a number of canoes to sell as artefacts. A small canoe which he made is part of the collection of the Museum and Art Galleries of the Northern Territory. Annie Karrakayn had not worked on a canoe before, but like the others she has an intimate knowledge of dugout canoes gained from years of experience using them. She recalls, for instance, literally growing up in one: 'When Tim[2] had that big boat, that canoe, we used to stick in that canoe . . . big mob of kid, right up'.

Walayungkuma and Karrakayn usually live on their outstation Wardawardala, which is about 30 km from Borroloola. Ninganga once lived in this area, but since being widowed usually lives in Borroloola. Ninganga and Karrakayn are Yanyuwa speakers and Walayungkuma is a Garawa speaker. All three spent much of their younger days living on or near the Sir Edward Pellew Islands which are located at the mouth of the McArthur River. All three used dugout canoes regularly to move from island to island or to visit the mainland.

Canoes in the area were usually made by a group of people but it is new for women to help in this process, as Annie Karrakayn notes: 'Someone was helping one another, two or three or four . . . but man used to work before, not woman, woman used to go hunting for food'. A good description of how canoe making was a communal affair comes from Tim Rakuwurlma: 'We doublebank,[3] two fella first time cut him, two fella man, right two fella sit down, another two fella now, long time you know'. On another occasion after a particularly tiring day's work Annie Karrakayn also exclaimed: 'just men [used to make canoes], that's first time lady, me and her, that's the first time for us, and I'm sick of this too . . . yeah! Because I know women didn't work, only man'.

The selection of a suitable tree took four exhausting days of searching along the McArthur River. The main selection criteria were size, straightness and a lack of branches and holes in the bark. Great attention was also paid to checking whether there were any holes beneath the bark extending into the trunk. The canoe was made from a large paper-bark tree *Melaleuca argentea*, known in Yanyuwa as **Binjirri**, which was felled on the banks of the McArthur River about 10 km upstream of Borroloola. There are two tree species in the area which are suitable for canoe construction, this *Melaleuca* and the 'Leichhardt pine', *Nauclea orientalis*; both are common along freshwater streams in the area.

Local Aboriginal people have differing opinions on the relative virtues of making canoes from these two trees. These conflicting views are based on the fact that while the Leichhardt pine is definitely easier to work, the much harder *Melaleuca* makes a canoe which is considerably longer lasting. The advantages of Leichhardt pines are discussed by Tom Wambarirri: 'Leichhardt tree . . . easier to cut him' and by Tim Rakuwurlma: 'Leichhardt tree more soft, good one, you finish quick'. Because of the number of canoes that have been made in the area in the past from Leichhardt pines, there are not any large trees of this species left. Therefore when the canoe makers were asked to make a 'proper big sea going canoe' a *Melaleuca* was the only choice possible. The smaller Leichhardts are only suitable for 'kid canoes'. The Yanyuwa used to construct small canoes known as **a-dubarl** for children to use. A number of people have told me how as children they were given canoes 'for training'.

The spot where the tree was felled and the canoe was constructed is close to a lagoon called Kalwanyi (Fig. 1) which also has the European name of Goose Lagoon. At this spot in the late dry season, the McArthur River is reduced to a trickle and the tidal reaches of the river are some 10 km downstream. In the dry season the river from Kalwanyi to the tidal reaches consists of a series of fresh water billabongs separated by a combination of stony bars and sandy banks. At this time of year a canoe cannot be paddled downstream.

In earlier times canoes were usually made upstream on the McArthur River in the late dry season and then moved downstream when the river levels rose after the first wet season rains. This sometimes involved using ropes to pull canoes across shallow bars. As Eileen Manankurramara recalls: 'They been put him cross stick and pull him . . . push that canoe right up long big river'. Usually however, the local rainmaker is said to have provided rain at the appropriate time to enable the canoe to be floated all the way down the river. Tim describes how one year he had to go downstream to Borroloola to tell the rainmaker to delay the rain as the canoe makers had not quite finished the canoe. He recalls the following exchange between the rainmaker and himself:

> Tim Rakuwurlma: 'Don't make rain yet'.
> Billy Hooker: 'Right you finish him up, all right come back . . . when you finished that canoe, all right . . . I'll send him flood for you, floodwater.'

In keeping with Yanyuwa tradition the canoe is called 'Rra-Kalwanyimara', which can be translated

FIGURE 2. The canoe makers, left to right: Ninanga, Karrakayn and Walayungkuma. Also Kylie Marikbalinya, granddaughter of Karrakayn and Walayungkuma.

literally as 'the female one from Kalwanyi'. As Annie Karrakayn puts it: 'All the canoe got name . . . [from the] country where they come from'. Tim Rakuwurlma called one of his canoes made in the Kalwanyi area, 'Rra-Kudanjimara', because the country around this area belongs to Kudanji people. There are two general Yanyuwa terms for dugout canoes: **rra-muwarda** and **rra-libaliba**. The latter is of Macassan[4] origin and the former is by far the most commonly used term.

The canoe construction camp was only about 30 minutes drive from Borroloola. This proximity enabled me to bring out a number of the elderly former canoe makers who were keen to see how the construction was going. I was told to bring out certain people whose opinions were valued. The comments these former canoe makers made on these visits made it very clear that there was a community standard of what a 'proper olden time canoe' looked like and that the canoe makers had to meet this standard.

As well as the canoe, the following items were made to go with it (see Fig. 3):

1. Paddles were made by Isaac Walayungkuma from a 'Pine tree', **walkuwalku** *(Callitris intratropica).*

2. A sail and mast were made by Annie Karrakayn and Isaac Walayungkuma respectively. The mast was made from a small messmate tree, **budanja** *(Eucalyptus tetradonta),* and the sail was made from calico.

3. Jerry Rrawyajinda made a dugong rope which is used when harpooning dugongs (and salt water turtles) from boats. To make the rope the bark of young **ma-kawurrka** *(Acacia torulosa),* saplings is pulled off in long strips. These strips of bark are called **na-wamara** and are pulled apart into thin threads which in turn are rolled into twine and then made into a two-ply rope. A number of separate trips were made to get the bark necessary for the rope. Most of the bark came from Wulukulirni and Ngangkungani (Fig. 1).

4. Don Manarra made dugong hunting points, **na-malbi**, and a dugong harpoon, **ridiridi**, with 'sugar bag' wax[5] binding. The points were made from the wood of the mangrove, **arndiny**, *Lumnitzera racemosa* and the harpoon was made from the straight trunk of a young messmate tree, **budanja** *(Eucalyptus tetradonta).*

Construction time

The tree was felled on July 16th. The first work on hollowing out the canoe started on July 19th and

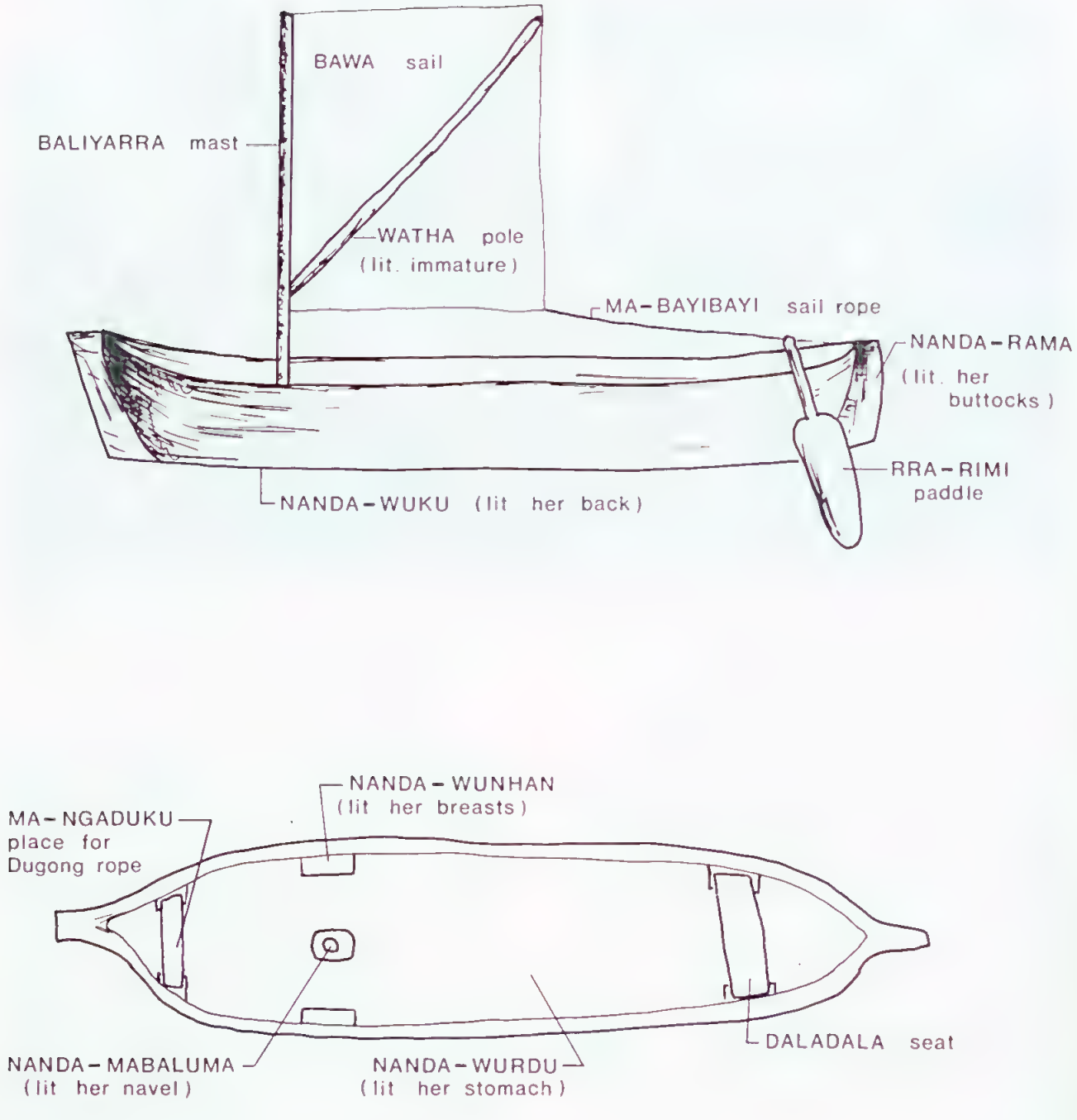

FIGURE 3. Yanyuwa terms for parts of a dugout canoe.

it was exactly a month later that it was moved into Borroloola. Whilst the canoe was *in situ*, work usually proceeded six days a week, with the three canoe makers each averaging eight hours work a day. The canoe was moved into Borroloola before it was completely finished as one canoe maker in particular was keen to return to town. Work on the canoe was much less consistent once it was moved to town. Pressures of town living and the fact that the canoe was locked up inside the Adult Education Workshop and work could only proceed when this building was unlocked, limited the times the canoe makers could work. If we had remained in the bush, I think the canoe would have been finished in about another six working days. A rough estimate for person hours for construction is 720 person hours

based on three people working eight hours a day for 30 days.

This figure corresponds approximately to the only piece of historical information I have been able to obtain on the time it took to make a canoe in the old days. This comes from Don McLean.[6] He told me of seeing a canoe made: 'It had taken six of them seven days to hollow this . . . The lump of timber was 15 feet [4.5 m] long but it took them seven days . . . They worked day and night, there'd always be someone [working]'. If one estimates that each man averaged 10 hours a day, this would represent 420 man hours. There are two likely reasons why this figure would be less than that for 'Rra-Kalwanyimara'. First, the canoe McLean saw was about 50 cm smaller if his recollection of 15 feet is correct. Second, it is quite likely that the canoe he observed had been worked on before it was moved to the spot where he saw it. The construction work that he saw occurred near the mouth of the McArthur River. It is likely that at least some work had been done on the log to lighten it and make it easier to move, prior to it being floated to the construction site.

Construction methods

After felling, the tree had its bark stripped and the hollowing out of the log was begun. This involved making a series of cuts[7] with tomahawks and axes[8] at right angles across the log at about 20 cm intervals. This formed a series of blocks which could then be removed when they were hit by a large adze swung parallel to the long axis of the log (*see* Fig. 4). Most of the hollowing out was done in this way. A smaller adze was used to do some chipping out of the insides and then the tomahawks were used to do finer work. Finally, files were used inside to smooth the surface. On the outside of the canoe the same combination of tomahawks and files was used. The hardest work was the construction of the two ends. This was done by Isaac Walayungkuma using a large axe. This was the only example of one of the canoe makers doing all of a specific job. All the rest of the work was shared by the canoe makers. When the series of cross cuts were being put in, it was possible for all three to work at the same time. However, when the blocks were being removed it was safe for only the person doing this to be in the canoe. Walayungkuma did most of this block removing but Karrakayn and Ningana also did some.

Towards the end of the four weeks' work at the canoe camp the canoe was burnt inside and out. Some of the chips of wood that had been chopped off, plus dead leaves and twigs from the felled tree were gathered and placed inside and under the canoe and burnt. The burning material inside the canoe was stoked by long poles. The flames burnt for about five minutes and then the fire smouldered for about another ten minutes. The fire was of low intensity and was carefully monitored to make sure it did not get too hot. This burning was done for two reasons, to aid the smoothing up of the canoe and to allow it to be 'spread'. The spreading was achieved by ramming some cross sticks inside the canoe flush against both sides and then burning the inside of the canoe. As Annie Karrakayn notes, the burning and ramming of cross sticks is to 'make it wide and [to] clean him really, make him smooth . . . that canoe got to burn first, then when it finished flame fire, you can hit him [the stick] then, knock him in, knock, knock, . . . that stick fall, that mean he wider'. When 'Rra-Kalwanyimara' was burnt it spread sufficiently for the cross sticks, previously flush against both sides, to be easily knocked down to the canoe floor. Then, as soon as the fire was cool enough, rasping inside the canoe commenced.

Another good description of burning comes from Steve Johnson:

> They used to fill [the canoe] up with water and let it soak for a while and then put the fire in it, put grass and all the shavings. Not stuff that'd burn a hole in it, but enough to heat it up, then they'd put the sticks in and bash the sticks in to spread it. They'd spread them a bit at a time, spread them about an inch today and then they'd push them back, sink them in the water . . . and in about a weeks time they'd get into them again and do the same thing. They used to do that for months after. Some of them used to go too far and they'd start cracking on the bottom . . . from too much spreading.[9]

Steve goes on to note that the expert canoe makers knew from experience exactly how far a tree could be spread without cracking it. Steve on another occasion gave the following reasons why Mac and George Riley made the best canoes: 'Everything they cut was good because they knew how to line them up and straighten them, they cut them with the timber and they were really good boats they made. If the tree wasn't good enough they wouldn't start on it'.

Initially the canoe construction of 'Rra-Kalwanyimara' occurred on the spot where the tree had fallen. Later, when the canoe was light enough, it was moved further down the bank. This was done by using a number of poles, cut from the trunks of small trees, as levers and also by placing the canoe on rollers made from short sections of tree trunks. It was first placed on a sandy bank and, later, on a rocky bar. The latter site had the advantage that the canoe could be raised on large stones and the fire could, therefore, burn immediately underneath it. As Annie Karrakayn put it, the canoe was moved 'because [the new spot] good place, so

FIGURE 4. 'Rra-Kalwanyimara' in the first stages of construction, July 1987.

we can put bushes underneath, chips'. The 'bushes' and 'chips' Annie refers to were put under the canoe and set alight as part of the burning process described above. Another advantage of moving the canoe onto the stones was that the canoe could now be leant from one side to another so that the under surfaces could be worked on.

When the canoe makers had a day off to go hunting or shopping in town they very carefully covered with strips of paperbark all surfaces that would be exposed to the sun. Annie Karrakayn explained why they did this: 'We go back home now, town, so we covered that canoe, just keep him away sun, he might get crack . . . if it's dry he'll crack but we have got to put paperbark and cover it . . . everyday when we go out'.

On the 14th of August the canoe was 'launched' by moving it the 10 m to the McArthur River. It was taken for a test paddle and the balance of the canoe was carefully assessed to determine where the most weight had to be taken off in the final finishing up work. This balancing work was subsequently done at Borroloola.

On the 19th of August the canoe was towed into Borroloola after winching it up the bank and onto a boat trailer. Work on finishing the canoe then proceeded inside the Adult Education Workshop in Borroloola. The canoe was 'made lighter' with tomahawks and files. Some further shaping of the two ends of the canoe also occurred. At the end of each day's work, the canoe was filled up with water and covered with wet blankets to keep it from drying out too fast.

Finishing the canoe in town fits in with what usually occurred in the past. The canoes were taken down the river to Borroloola before the canoe makers had completely finished them. They then worked on them at their leisure on the banks of the river. In the past, as occurred with 'Rra-Kalwanyimara', the canoes were paddled to see how well they floated. If necessary, the canoe makers would lighten particular areas to improve the balance. During this 'finishing off' period the canoes were often filled up with water and left in the river so that the wood did not dry out too quickly. A number of people remarked that the purpose of bringing the canoe to town and finishing it slowly was to allow the timber to dry out slowly and thus to avoid cracking.

The mast for the sail was fitted into the canoe when it was in Borroloola. This was done by drilling a hole only fractionally larger than the mast in a board that rests firmly between the **nanda-wunhan** (Fig. 3). The mast was then lowered through this hole and lodged firmly in another hole in a mound, **nanda-mabaluma**, left in the base of the canoe for this purpose. The rear seat or **daladala** and the front 'seat', **ma-ngaduku** for the dugong rope to rest on were also made in Borroloola. These were made out of timber from the 'Leichhardt Pine' *(Nauclea orientalis)*. The wood from old packing cases is said to be ideal for these seats and was much used in the past.

History of Aboriginal Watercraft in the Borroloola Area

Logs and rafts

The simplest type of watercraft used by Aboriginal people in the Borroloola area was a swimming log. Tim Rakuwurlma told me how he and two other Yanyuwa men had to 'get a log' to help them swim from island to island in the Sir Edward Pellews after they jumped off a European lugger on which they had been employed. As well as providing extra buoyancy for the swimmer, such logs were felt to provide some safety from crocodiles and sharks. Herbert (n.d.: 155) observed people swimming the Roper River (200 km north-west of Borroloola) using such logs. He notes that: 'It was not clear whether the alligators regarded this apparition as a friendly object, or a deadly enemy charged with possibilities of destruction to themselves, but in either case the log was recognized by the native as a great safeguard'.

Rafts of various types were also constructed in the area. These were typically constructed on site, when groups who were walking needed to cross one of the large salt water rivers in the region. They were constructed in both triangular and rectangular shapes. The triangular rafts were similar to the Mornington Island one illustrated in MacIntyre (1921: 60) and the Bardi ones from Western Australia (Ackerman 1975: Fig. 1).

The Yanyuwa made rafts by lashing together a number of thick logs, using twine made from the bark of the following trees: **karraki** (*Wrightia saligna*), **ma-lhalhaki** or **ma-murndurrarra** (*Brachychiton diversifolius*), **ma-rdardaki** or **ma-yatha** (*Brachychiton paradoxus*) and **ma-kawurrka** (*Acacia torulosa*). Twine was also sometimes made from lily stems. Paperbark was piled on top of the lashed logs to raise the craft above the water. Thomson (1957) and Davidson (1935) note that such rafts were used across the whole of northern Australia.

Bark canoes

Bark canoes, known in Yanyuwa as **na-wulka**, were made by sewing together the bark of the messmate tree *(Eucalyptus tetradonta)*. They were made in the area before dugout canoes were constructed. As Isaac Walayungkuma notes, they were 'olden

time, first time canoe . . . that first time they been make them'. The Yanyuwa bark canoes were quite distinct from Garawa ones made to the east, which were smaller and made from a single piece of bark. The Garawa ones were only used in calm waters while the Yanyuwa canoes were suited to the rough conditions that could be encountered in voyages from the mainland to their islands. The Yanyuwa canoes had rounded sterns and had extra height in the bow to stop waves washing in.

The first written account of Yanyuwa bark canoes is contained in Flinders' description of his voyage around the Sir Edward Pellew Group in December 1802. He found on North Island two canoes 'formed of slips of bark, like planks, sewed together, the edge of one slip overlaying another, as in our clincher-built boats' (Flinders 1814, 2: 171). He also notes that 'their construction was much superior to that on any other part of Terra Australis hitherto discovered' (*ibid.*: 172). On the grounds of this superior construction, he questions whether they were made by Aboriginal people.

Bark canoes of varying types were made across a wide area of northern Australia (*see* Bell 1956, Davidson 1935, Holland 1976, Hornell 1940 and Thomson 1934a, 1934b, 1939, 1949a, 1949b, 1952 and 1957). Bell (1956) describes and illustrates with a series of photographs the steps involved in making a small bark canoe in the Archer River region of Cape York Peninsula. Thomson (1934a) describes the construction and use of bark and dugout canoes in the Batavia River area of Cape York. He concludes that the bark canoe is 'employed chiefly as a river craft, while the wooden outrigger canoe is a sea-going vessel and is used especially in dugong and turtle hunting' (Thomson 1934a: 229). In his 1934b article Thomson gives a detailed description of the dugout canoes and the dugong and turtle hunting carried out from them in the Stewart River area of eastern Cape York. In his 1939 article he documents a localised variation of bark canoes made for hunting geese and collecting eggs in the Arafura Swamp of north central Arnhem Land. Thomson's 1952 article is a review of the distribution of various watercraft across northern Australia. However, on his distributional map he incorrectly excludes the Sir Edward Pellew area from having both dugouts and bark canoes. Davidson (1935: 73), likewise, excludes the Pellew group, citing the eastern limits of dugout canoes as the Roper River.

Hornell (1940) presents a world-wide survey of canoe types and gives an unconvincing argument for an evolutionary transition from bark canoes to dugouts to plank boats. He does, however, give good detailed descriptions of three bark canoes made in the Borroloola area that he saw in the South Australian, Victorian and New South Wales state museums.

One of the best descriptions of a bark canoe being constructed is that of Banfield. He describes how a Cape York man got the bark 'raw from the tree [and how] he would soak the single sheet in water and while sodden, steam it over a smoky fire, and, as it softened, mould it with hand and knee' (1918: 127).

Despite their frailty these bark canoes were used by the Yanyuwa to make lengthy sea trips. Spencer & Gillen, who were in Borroloola in 1901, describe (1912: 484) a bark canoe carrying six men from Vanderlin Island to Borroloola. This is a voyage of about 50 km across the Gulf of Carpentaria then 50 km up the McArthur River. Spencer & Gillen also include a detailed sketch of a bark canoe (*ibid.*: 483) and give a description of their manufacture (*ibid.*: 482-484). Tim Rakuwurlma has told me of a Yanyuwa revenge party that sailed all the way to and from Massacre Inlet in Queensland in bark canoes, a return trip of about 400 km. This trip was made at the turn of the century and as Tim notes, it was made in paperbark canoes: '**nu-wulka** . . . paddle him all the way'. Dinny Nyliba McDinny also recalled in 1986 how, when he was young, his family travelled back and forth in bark canoes along the Gulf of Carpentaria coast between Manangoora and Robinson River, a distance of about 100 km each way.

Spencer in his notebook gives a detailed description of how these bark canoes were constructed:

> The salt water men build very decent canoes. They strip . . . long pieces of bark off the big wattle trees and sew them together at each end and then they have a long thin bough which forms the gunwal on each side . . . [and which] are held tightly stretched by means of sticks which run across from side to side. Some of these canoes are twelve and fifteen feet long and will hold three or four men (Spencer 1901: 98).[10]

Bark canoes remained in use in the area after the Macassans introduced dugout canoes, presumably because of the ease of bark canoe construction. Paradice gives an example of the continuing use of bark canoes, recording a 'very fine canoe — twenty feet long — [that] was made of a large sheet of bark' (Paradice 1924: 7) and includes a photograph of it. Similarly Pyro Dirdiyalma who was born around 1930 and who grew up in Garawa country on the coast to the east of Borroloola, recalls such canoes being used but also notes that bark canoes were becoming rare ('just about finished'), when he was young. Tim Rakuwurlma describes how a bark canoe could be made in only two days: '**Na-wulka** . . . I been make that kind . . . not hard work like canoe, him two days that is all . . . mend [sew] him all the way . . . tie him quick, we been mend him with that string now'.

Because of the ease of their construction, the bark canoes could be treated in a fairly 'disposable' manner. Brown, the Northern Territory Government Geologist, for example, visited the Borroloola area in 1907 and described how a bark canoe was paddled out to meet the steamer 'and as the canoe was stove in against the side of the vessel they let it float away and remained on board' (Brown 1908: 6). Brown goes on to also describe (*ibid*: 7) how they 'passed canoes with blacks crossing the river on two or three occasions'.

Whilst bark canoes had the advantage of quick construction they were not nearly as durable or as safe as dugout canoes. Many Yanyuwa people can recount stories of relatives drowning as a result of bark canoe mishaps. Tim Rakuwurlma, for example, describes his older brother drowning in one such incident that Tim managed to survive by holding onto his mother: 'My mother, I been hold [her] shoulder all the way long Wulibirra country [the nearest landfall to the spot where the canoe sank] . . . bark canoe, no good one . . . he been leak, when no canoe yet . . . behind [after], him been make [dugout canoes]'. On another occasion Tim told me, 'no good bugger, plenty men been drown . . . more good one Leichhardt tree, leave that messmate canoe now, leave him altogether'. Isaac Walayungkuma and Annie Karrakayn in the following exchange also stress the dangers of bark canoes and the comparative advantages of dugouts:

> Isaac Walayungkuma — Wulganyi[11] he drowned for good now, he can't float, no further, he sink right down finish.
> Annie Karrakayn — [dugout canoes when full of water] turn him around . . . or sometime just bail him out quickly [indicates doing this by shaking the canoes back and forth].

Another important advantage which dugouts have over bark canoes was that they are sturdy enough to allow the erection of a mast and sail. As well as making the canoes faster and saving much effort in paddling, the sails add to the handling of canoes. The anthropologist Donald Thomson, who made great use of both canoe types in his travels in northern Australia, notes (1957: 19) that sails, 'helped steady the craft in a following sea'. It should be noted, however, that sails of a sort were used in paperbark canoes. A number of people have described to me branches being put up in paperbark canoes as sails. Tim Rakuwurlma should be given the final say on the disadvantages of paperbark canoes with this dramatic comment:

> When something bite him, shark, well he been drown, everybody been drown long middle water . . . sometime blind shark . . . bite him make a hole . . . when you go early fella morning, go along sea now, shark come along you, bite him that canoe, knock him down, early fella morning he'll bite anything.

Introduction of dugout canoes

Spencer & Gillen record both dugout and messmate canoes in use in the Borroloola area in 1901. Aboriginal and historical records right across the 'Top End' of the Northern Territory suggest that production of dugouts did not commence until after the Macassans stopped coming and supplying them. Warner (1969: 459) and Thomson (1937) both quote informants who say dugout canoes were not made until the Macassans stopped bringing them. Thomson (1952: 3) makes the same point but in more general terms and does not mention the informant. Warner goes on to suggest that in the area where he was working (north-eastern Arnhem Land), people reverted to using paperbark canoes for a while until they learned how to construct dugouts from Aboriginal people from the English Company Islands. Worsley (1954: 61–62) from his work on Groote Eylandt, also concludes that dugout canoes were obtained from the Macassans and not made until after they stopped their visits to northern Australia. Heath (1980: 532) presents a Nunggubuyu text (from the Roper River area) that describes how bark canoes were used first and that the dugouts were introduced later as a result of Macassan contact.

Tim Rakuwurlma's account given to me in 1983 supports this suggestion:

> My father, messmate [canoe], him been have first time. By and by, he been think about now, him been find big tree there, Leichhardt tree, along island along him country.
> 'I think I'll cut him'.
> I been big boy, I never had corroborree along me yet [he had not been through circumcision initiation ceremony]. That big I been [indicated about 10 years old] and old Banjo [his older brother] was there.
> 'I think I want to cut him canoe along you two fella, we got to make him canoe **libaliba**'. Him been talk.
> 'We've got to make him **libaliba**'.
> 'Go on'.
> 'Yeah I been look that mob from Groote Eylandt, Ingura mob been learn me'.
> Old fella been learn him my father long Groote Eylandt people, blackfella. When them been come along that big boat Malay[12] men, coloured men. That mob been learn him, him cut [the dugout canoe] himself . . . long tomahawk.

The first Yanyuwa-made dugout canoe was constructed well inland and as Tim describes, 'we all been pull him down . . . all the way [to the coast]'. In 1987 Tim told me this story again and after noting that the early canoes were made from a Leichhardt Pine, says 'tea-tree (*Melaleuca* sp.) that

one behind [after], we been cut that kind when my father been finished . . . when no more Leichhardt tree there long island, my father been finish them up. We been go along McArthur River higher up'.

Using Tim's mention of his age in the above quote, this first Yanyuwa-made dugout can be dated to about 1910. This corresponds with the information presented by Warner and Thomson that canoes were not constructed until after the Macassans stopped coming. The last voyage made by the Macassans to Australia was in 1906–1907 (Macknight 1976: 126). Further support for this post-Macassan commencement of canoe construction comes from Stretton's (1893) comments on how Aboriginal people on Vanderlin Island obtained their canoes. Writing in the decade before the Macassan visits stopped he notes that 'the Vanderlin tribe are expert canoeists, and are possessed of some very fine canoes, made out of solid trees, which have been left behind by the Malays' (Stretton 1893: 228). He makes no mention of the Yanyuwa building their own dugout canoes.

The rise and decline of Yanyuwa canoe making

Yanyuwa canoe making probably reached a peak in the 1930s and 1940s when, with ready access to European metal tools, a large number were made. Several of the European residents in Borroloola commissioned canoes and these were sometimes used to transport stores up the McArthur River. The canoes carried the supplies upstream from the landing some 30 km downstream where the coastal supply boat unloaded the cargo. The vital part these Europeans provided in the construction of the canoes was the supply, as payment, of preservable food such as flour. As Tim Rakuwurlma observes, canoes took a long time to make and the canoe makers were dependent on others to provide them with food during the period they were working full time: 'Might be three weeks . . . long time no tucker . . . but this time big mob of tucker flour'. Tim goes on to note how he made canoes with food being provided by a European called Havey and compares this food source with that his father lived on when he made canoes. 'Charlie Havey alla [always] send tucker for me . . . get a bag of flour all the way . . . my father been cut a canoe and he been had **munja**[13] . . . cooked by my mother'.

It was not only Europeans who commissioned canoes, Aboriginal people also commissioned canoes from a number of expert canoe makers. The terms of this trade included supplying the maker with food during the construction phase and then giving a proportion of food caught from the canoe for sometime afterwards. Steve Johnson describes Mac Riley making canoes 'for trade' and says he got half the catch for the first six months of the canoe's life as part payment. Tim Rakuwurlma also describes how Mac made him a canoe and sent it down from Mara country (to the north-west) to him and how he kept the Mara name given to this canoe: 'I been buy him long blanket . . . him been make him long his country . . . 'Bayilmalkulma' . . . that mob Mara [named it] . . . I been keep name they been call him that way'. Mac is also mentioned in the Welfare Department files (Australian Archives 1952) as having made (with others) five canoes in 1952.

Tim Rakuwurlma who supplied me with much of my information on Yanyuwa canoes, was a particularly renowned canoe maker. As Ted Egan recounts:

> Old Tim was always working on a canoe . . . float it down . . . half make it and either carry it or float it to a beach and finish it there . . . he was referred to as much by the term the 'canoe man' as 'Old Tim'.[14]

Egan also recalls how a European boat would sometimes tow dugout canoes: 'They had about ten canoes when I was there. Jack Bailey had a wonderful old chug chug boat and Jack would often pull a string of canoes up the river'.

The South Australian film maker, Roy Vyse, visited Borroloola in July 1954 and describes[15] how 'hunting is done from dugout canoes of which there are a large number'. A missionary based in Borroloola describes how in 1958 'a party of sixteen had left' Borroloola to pick up 'about eleven canoes' that had been made at one location that year (Main 1958: 15). Kettle (1967: 95) reports seeing 14 dugout canoes at Borroloola in 1955. An interesting burst of canoe making occurred in 1961 when the Yanyuwa were moved by the Welfare Branch to Dangana on the Robinson River.[16] Musso Harvey recalls how six canoes were made in the seven or eight months people lived there and how 'we all [came] sailing back' to Borroloola.

Yanyuwa people also made canoes when they were away from Borroloola working on cattle stations. Some stations provided ready access to suitable large trees. The residential quarters on many stations in the region are located on springs that are lined with tall trees. Hence there was the opportunity to work on canoes during slack periods of the cattle work. As Jean Kirton[17] recalls, the Yanyuwa would often come back from the cattle stations on trucks with new canoes:

> When they came back there, maybe two or three canoes would come back on the backs of the trucks . . . there were all kind of good things associated with the coming of the wet season, all the relatives coming back and new canoes coming back with them.

Canoe construction began to decrease in the early 1960s as the Yanyuwa began to have the cash to buy European aluminium dinghies. The last canoe built by the Yanyuwa for their own use was made by 'Old Dhulu' in 1977 at Ryan's Bend. This particular canoe was commissioned by Tim Rakuwurlma and stayed in use until 1981. At the end of one day's work on 'Rra-Kalwanyimara' Annie Karrakayn remarked how all the old canoe makers 'been die now' and that no younger canoe makers had replaced them 'because they had the dinghy now, white fella dinghy'.

Use of dugout canoes

It is possible to document long voyages made by the Yanyuwa in dugout canoes. Pyro Dirdiyalma described how a relative used to travel all the way to Burketown in a dugout canoe (a distance of over 400 km each way) 'looking for tobacco'. Don McLean told me of a round trip of over 500 km he made in a dugout canoe with three Yanyuwa men in 1943 to and from Groote Eylandt. People also travelled from Borroloola to Numbulwar (250 km to the north-west), in dugout canoes to attend ceremonies. As Steve Johnson recalls, whenever possible such trips would have involved sailing and not paddling:

> They sailed them when the wind was favourable, they never paddled because they wanted to. Most of them waited for the wind to come the right way before they even start. Probably sit there for a week waiting for favourable weather . . . unless they were in a hurry there is no way they'd paddle against it. But if they were out there and got caught, some of them old fellas could paddle for days without getting off that paddle.

As well as being a means of transport, dugout canoes played an important role in the Yanyuwa economy. This was particularly the case with turtle and dugong hunting. It should be noted, however, that older Yanyuwa individuals are adamant that people did hunt dugong and turtle from bark canoes in the 'old days'. As Tim Rakuwurlma notes: 'They been make him messmate tree, bark [canoe] . . . big mob dugong killer, black fella, right up long Wunubarryi [100 km north-west of Borroloola]'. It is conceded however that the dugout is far superior for hunting due to its greater size and stability. Indeed the dugout is in many ways superior to the aluminium dinghies powered by outboard engines used today. As Mick Pollard recalls, Tyson Walayungkuma told him how dugout canoes were superior for dugong hunting as in 'them aluminium boat, you go out and your toenail touch that floor, them dugong go for one mile'. Dugong are renowned for their acute hearing. In a canoe a hunter could silently glide over herds of turtles and dugongs and literally take his pick. Today, however, hunting in aluminium boats involves a hair raising high speed chase as the hunters attempt to outrun the turtle and dugong. The canoes also obviously have the advantage of not requiring fuel. Today it is quite a logistic effort to carry enough fuel to make the long trip down the McArthur River, go hunting and still have enough fuel to return to Borroloola. Another disadvantage of outboard powered dinghies is the fact that the occupants usually get covered with spray when travelling in them.

The following Yanyuwa terms are given for the crew of a dugout canoe. The person behind, sitting on the **daladala** (Fig. 3) was called **ramangka ngulakari**, the person in the front of the canoe was called **ngurrungu** and the person in the middle was called **a-kuyila wumbiji**. However, when hunting dugong and turtle in the past in dugout canoes or today in aluminium dinghies, different names are used for the person at the front and at the back of the canoe. The dugong hunter in the front armed with the harpoon and looking for dugong is known as **maranja**. This person indicates with hand signals which way the **wungkayi** (who is sitting behind) should paddle.

Dugong hunters took great care of their hunting equipment. When on hunting trips, ropes were carefully coiled so they would not get tangled and the harpoon was mounted on the side of the canoe with nails holding it in place. The harpoon was placed on the right-hand side of the canoe for right-handed hunters and on the left side for left-handed hunters. Dugongs and turtles were often hunted at night, with the hunter following the phosphorescent trails left in the wake of the animals. Such night time hunting trips could be quite long and young children were often taken out and bedded down for a night's sleep in the canoe. On cold dry season nights another advantage of dugout canoes was that a fire could be lit in the canoe. As Steve Johnson told me:

> They used to have a fire going there [on] a big flat rock or sheet of iron and a bit of mud on it clay, have a fire going there all day. They'd be paddling down the river and you'd see smoke in the boat . . . they used to even cook a feed, cook a fish or something like that . . . if they went out for a long trip . . . they'd take a bit of extra wood with them, they'd anchor all day out there waiting for the dugong to come back in from the deeper water, if they had some fish they'd cook that up, they lived like kings out there . . . boil the billy . . . they'd cook a few crabs.

It was the job of the person in the middle of the canoe, the **a-kuyila wumbiji**, to keep the fire burning. These fires served the dual functions of cooking and keeping people warm. Isaac Walayungkuma

gives another description of these fires: 'Big canoe, you can put dugong and swag, put flat stone, make a fire there too'. Another good description of these fires is given by Ricket Murnudu in which he makes the point that when paddling the canoe the person behind was kept warm by the smoke drifting back: 'Fella in front he cold, but this one behind [is warm] because he keep smoking long him behind when he paddling'.

However, as Tim Rakuwurlma recalls, the results of not putting a fire out properly were serious. He describes how once, when he lent his canoe to his brother:

> Him been go out night time hunting and he been come back and been leave that boat there, he been wet that fire long salt water, wet him . . . but that fire been alight, canoe been burn him . . . [next morning] Banjo been come out. 'Ah that boat been drown here . . . oh I been burn [it] long fire'.

Tim goes on to describe how a European resident of the area 'been fix that boat now, got copper tack, copper nail and iron'.

As well as being used for hunting and carrying dugong and turtle, dugout canoes were also very useful for carrying loads of people, possessions and food. Annie Karrakayn notes for example how people used to 'fill him up **libaliba** . . . right up' with shell fish gathered from mudflats. Canoes were also filled up with sea bird chicks, gathered by shaking mangrove trees during the wet season. Sometimes these birds were also cooked on fires in the canoe. Large quantities of cycad fruit were also carried in canoes from where they grew to places where there was plenty of water to leach the toxic substances out of the cycad. Annie Karrakayn, for example, describes how people used to go to Manangoora where there are dense stands of cycads *(Cycas angulata)* and 'fill up canoe . . . and take him to . . . spring country, . . . soak it there now for eat'.

Canoes were also used to carry dogs. The last couple to travel regularly around in canoes, for a long time had one canoe each so that all their dogs could fit in. In the 1950s and 1960s when a large number of Yanyuwa people had moved in to Borroloola, dugout canoes were often used to carry fire-

FIGURE 5. Forty-four gallon drums being carried by canoes. Photograph Steve Johnson, circa 1955.

wood back to their camp. They were also used to carry strips of paperbark that were collected from trees along the river to roof the shelters people built for themselves in Borroloola.

It is not surprising considering the time people spent in canoes that at least one Yanyuwa person was actually born in one. Also a number of other births were apparently brought on when heavily pregnant women were paddling canoes and just managed to make landfall before giving birth.

Early government officials such as Patrol Officers also made use of dugout canoes to travel around the Borroloola area, as they were the only possible form of transport for much of the wet season. The long time regional head of the Welfare Branch, Les Penhall, described how 'We bought two dugouts off one of the Aborigines out there so we could have transport available'. As well as being used for carrying supplies (Fig. 5) up the river from the deep water jetty downstream, canoes were used by the Welfare Department to get good timber to Borroloola. Annie Karrakayn, for instance, recalls how people used to get pine trees (*Callitris intratropica*) downstream along the McArthur River and brought them back to Borroloola with 'that canoe, pulling behind like a trailer'.

A number of European crocodile shooters in the area also used dugouts, for, as when hunting dugong, the crocodile hunter could silently glide on top of the prey. Considerable use of dugout canoes was also made by the army unit that was based on the Sir Edward Pellew Group during World War II. Don McLean describes how canoes were used to carry supplies and personnel, to patrol for mines, to carry messages and to locate an American airman who once crash landed in the area.

Canoe size

Spencer's diary contains a good indication of how large were the canoes which the Yanyuwa obtained from the Macassans. He notes that:

> A big canoe has come up the river from the coast with about 20 natives in it. It is quite unlike the bark canoe and is simply a great log hollowed out and shaped into a boat. It is quite 30 feet long . . . This particular boat was made by the Malays who come all down the coast every year in their Prahus in quest of toitorse [sic] shell [and] bêche de mer which they barter for with the blacks (Spencer 1901: 110).

The largest canoe made in living memory was measured by Steve Johnson to be 27 feet (8.23 m) long and was called the 'Butterfly'. The Yanyuwa classify canoe size in terms of how many large salt-water turtles they would hold: the 'Butterfly' being a 'four turtle canoe'. Tim Rakuwurlma also comments on a 'four turtle canoe' and goes on to say that it could also carry four 44 gallon drums. 'Sonny' Raggatt, the former manager of a station for which supplies were brought up the river in canoes, recalls one canoe that carried five 44 gallon drums or forty 50 lb bags of flour.

Annie Karrakayn in the conversation quoted above on how all the kids used to 'stick in that canoe', notes that the canoe also carried 'big mob of load' which included swags, billy cans and 44 gallon drums. Another mention of the capacity of dugout canoes is in Griffin's (1941: 32) description of a visit to Borroloola. She records a canoe paddled by Tim Rakuwurlma's brother Banjo carrying 'his lubra, and her sister, two piccaninnies, two dogs, one puppy, two galahs, and coolamons of lily seeds, roots and wild raspberries, not to mention billies and pannikins'.

Canoe life-span

Most dugout canoes appear to have lasted less than three years. Thomson (1934: 244) discusses the short life-span of canoes at Stewart River, Cape York, and comments on one lasting only seven to eight months. The fact that one canoe lasted five years before it sank is noted as being unusual by Johnson Babaramila Timothy: 'Him sunk down . . . might have been too old. One boat from Roper, we had it for long time, for about, might have been more than five years'. The oldest canoe described to me was the last one owned by Tyson Walayungkuma. This canoe, according to Steve Johnson, was a 'good ten years old' when it was finally too rotten to patch up any more.

The spreading of canoes, described above, makes canoes particularly susceptible to cracking. As well, boring water worms tended to eat through the canoes. Canoes were constantly patched, using the reddish bark of **ma-wunjurrwunjurr** (*Terminalia carpentariae*), a tree that grows on the Sir Edward Pellew Islands. As Steve Johnson notes: 'They used to use that, scrape the bark off . . . and they'd pound it up into a putty and then use that to shut the cracks'. When available, however, iron and tacks were considered preferable. As Steve goes on to note, **ma-wunjurrwunjurr** bark was only used 'if they were out bush and didn't have that gear [metal] . . . they even used mud, that hard clay for repairs'. Canoes were often removed from the water and rolled over to dry in the sun in attempts to kill the borers. Also, canoes were painted with a red ochre to protect them from worms. When available, tar, pitch and various boating oils were used as they were more effective.

Jean Kirton gives a good summary of the problems people had maintaining their canoes and illus-

trates why aluminium dinghies were so readily adopted in preference to dugouts:

> There were two kinds of borer that got into them, a freshwater one and a saltwater one and most of them only lasted two years. They would patch them and they would leak a lot. It got to the stage where they would leak so much they would be under water, [it] gets a bit discouraging bailing something when the entire thing is under water every time you want to use it. So [at] that point it got relegated to being drowned. When you could get an aluminium dinghy that borer did nothing to it.

Conclusion

The Yanyuwa history of canoe making is a good example of Aboriginal culture's quick response to change. Canoes were readily adopted by the Yanyuwa as they were a better version of something they already had. As such they represent cultural change very much on Yanyuwa terms. Use of dugout canoes allowed the Yanyuwa to exploit their environment in new ways. Resources such as bird and turtle eggs on isolated islands could be obtained and previous activities such as turtle and dugong hunting would have been both safer and more productive.

Methods of construction and repair of dugout canoes changed according to supply of natural resources, and to the provision of European tools and food sources. The move to use aluminium boats instead of dugouts occurred for the same reasons that dugouts were originally adopted. The new item had great advantages.

In the case of adoption of aluminium boats however, as has been the case for many aspects of European culture adopted by Aboriginal people, there have been unforeseen ramifications. The decline in canoe making has been but one part of an overall pattern of greater dependency on European resources and services that has led to a great reduction in Yanyuwa independence overall. The decision to adopt European dinghies occurred in the late 1960s when, with the granting of equal wages on cattle stations, there was plenty of cash about to buy dinghies. However, the prosperity of this time was short-lived. Massive lay-offs of Aboriginal people in the cattle industry in the 1970s have resulted in very few Yanyuwa people currently being employed. Today, there is little money to buy dinghies or outboard motors and often not enough mechanical 'know how' to keep those motors going.

Hence Tim Rakuwurlma (Fig. 6) who spent much of the first two-thirds of his 90 years travelling in dugout canoes around his island country, can now lament 'I want to go island, sit down long island, but no boat too much . . . I got no boat too much, I want to sit down long my country'.

FIGURE 6. Tim Rakuwurlma and his canoe, July 1954. From the Les Penhall Collection, Northern Territory State Reference Library. Reproduced with Penhall's permission.

Acknowledgments

I wish to thank all the Yanyuwa people who shared with me their knowledge of canoes. I am also most grateful to all the non-Aboriginal people with experience in the Borroloola area who helped me with their memories of Yanyuwa canoe use. I thank the Australian National Maritime Museum for giving permission to publish here sections of a report I prepared for them. Research in the Borroloola area has also been supported by the Australian Institute of Aboriginal Studies, the University of Adelaide, the Northern Australian Research Unit of the Australian National University and the Royal Geographic Society of Australasia (South Australian Branch). In addition, I wish to thank Chris Anderson, Michael Bardsley, Fay Gale, Philip Jones, and Beth Slatyer for useful comments on earlier drafts of this paper. I am also particularly indebted to John Bradley for all his logistic and linguistic assistance.

Endnotes

1. All the conversations quoted are from recorded interviews, now lodged with the Australian Institute of Aboriginal Studies in Canberra. A copy of this paper footnoted with details of tape number for each quote and the place on the tape where the conversation occurs is lodged with the A.I.A.S. Most quotes are from Aboriginal people from the Borroloola area. Where the quotes are not from Aboriginal people, I give in an endnote, background information on how the individual concerned came to be in the area. A detailed set of photographs documenting the construction is also lodged at the A.I.A.S., as are a number of historic collections of photographs which I have located relating to the area and which include photographs of canoes.

2. She is referring here to Tim Rakuwurlma, an old Yanyuwa man who has supplied me with much of my information on Yanyuwa watercraft. Tim was born some time late last century.

3. This is an Aboriginal English term for helping someone.

4. Macassans are fishermen who came to northern Australia from the port of Macassar in the Celebes (now known as Ujung Pandang and Sulawesi respectively) prior to European settlement of Australia. Their visits stopped in 1907 as a result of South Australian Government legislation. They came to collect, amongst other things, trepang. (*See* Macknight 1969, 1972 and 1976 for further details.)

5. 'Sugar bag' is an Aboriginal English term for the native bee nests that contain wax and honey.

6. A European soldier based on the Sir Edward Pellew Group during part of World War II.

7. The photographic recording of the canoe construction illustrates each stage of production it went through. The copy of this article lodged with the A.I.A.S. includes a daily record that details each photograph taken.

8. All tools used were purchased metal ones. In the recent past most work was done with similar tools. Don McLean, however, recalls seeing 'wedges made out of stone and they were on a long handle . . . like an adze' and describes them being used in the same way I observed large steel adzes being used.

9. Steve Johnson has lived all his life on Vanderlin Island. His father was a European trepanger who lived most of his life there with Steve's mother, a Yanyuwa woman. Steve has a detailed knowledge of canoes from the use Aboriginal people made of them around his home, Vanderlin Island.

10. Spencer & Gillen collected one such canoe which is now held by the National Museum of Victoria. The South Australian Museum also holds a canoe collected from Borroloola around the turn of the century and Hornell (1940) also gives a detailed description of another bark canoe made in the Borroloola region, held by the Australian Museum in Sydney.

11. As noted above, Isaac Walayungkuma is a Garawa speaker and hence uses this Garawa term and not the Yanyuwa term **Na-wulka**. Trigger (1987: 80) mentions Garawa watercraft and notes the Garawa use of this term for bark canoes.

12. 'Malay' was the incorrect term Europeans applied for a long time to the Macassan trepangers. Tim would have learned this from Europeans and not from the Macassans themselves. The Groote Eylandt Aboriginal people Tim mentions came down on the Macassan boats.

13. A term for the cycad that grows in abundance in the area. It is processed to leach out toxic substances and is then prepared into preservable dampers.

14. Egan was the relieving Welfare Officer at Borroloola for a number of brief periods in the 1950s.

15. This quote comes from S.A. Museum Archives Acc. No. 1676, which is a notebook of his trip. Vyse made a film of his trip (also held by South Australian Museum) which includes a shot of Tim Rakuwurlma paddling a canoe across the McArthur River. The photograph in Fig. 6 was also taken at this time.

16. The Northern Territory Welfare Branch Annual Report 1960/61: 76 documents the move of 133 Aboriginal people previously resident at Borroloola.

17. Jean Kirton has worked as a linguist at Borroloola since 1963.

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REVIEW

The Dynamic Partnership: Birds and Plants in Southern Australia edited by Hugh Ford & David Paton. The Flora and Fauna of South Australia Handbooks Committee, Adelaide, 1986. 199 pp., 8 colour plates, 23 figures, 38 tables. Paperbound, $A19.50.

The editors, Hugh Ford (University of New England) and David Paton (University of Adelaide), themselves contributors to the book, are to be commended for bringing together much of the current understanding of bird-plant relationships in southern Australia — as yet a relatively little studied field. The resulting publication is the first broadly-based treatise on this subject for Australia. The title suggests that the book pertains to southern regions of Australia only, but in fact many of the hypotheses and conclusions put forward may be applicable to most of the continent.

The book is divided into sixteen chapters, and each discusses a particular aspect of bird-plant interactions. Some are specific, such as the pollination and seed dispersal of mistletoes (by N. Reid), and others are more generalised, such as lifestyles and food resources of birds in inland environments (by K.S. Shurcliff). Some authors largely restrict their discussions to an analysis of the available data, for example P.A. Paton in her chapter on the use of aquatic plants by birds in the Coorong, South Australia. Others are more speculative, for example D.C. Paton in his chapter on the evolution of bird pollination in Australia. Inevitably with such a diversity of topics, the book is essentially a collection of papers. However, the editors have grouped those with similar themes, except for some that fall into no particular category, and there is some cross-referencing between chapters. This, together with the provision of introductory and concluding chapters, gives a degree of continuity throughout. Despite the diversity of material discussed, there are still several aspects of bird-plant interactions left unexplored, such as the use of plants for nest sites and nesting materials. But as is suggested in the introductory chapter, some subjects are beyond the scope of the book; these may well serve as the basis for future publications.

Most of the book deals with endemic plant and bird communities, but two chapters examine the adaptations to and utilisation of exotic habitats by birds, in comparison with adjacent areas of native habitat. These are studies in suburban gardens (by R.J. Green) and pine forests (by B.C. Gepp). I found A.V. Milewski's chapter, also comparing bird communities in different habitats, particularly interesting. In this case they are both endemic habitats — southern Australia and southern Africa. Despite the presence of many plant and bird families that are the same in both regions, Milewski points out some distinct differences, which he attributes to climatic and soil differences between the continents. Thus in southern Africa there is a diversity of birds that consume fleshy fruits and of plants that produce them, while in southern Australia there is a diversity of honeyeaters and nectar-producing plants.

Much of the book examines bird-plant interactions from the point of view of the use of or dependence on plant species by particular birds, or of the mutualistic relationship between the two groups. Chapter 15 (by H.A. Ford) on birds and eucalypt dieback, however, is taken from the point of view of plants' dependence on birds not just for enhanced dispersal of pollen and seed but more directly for their health and survival. This and several other chapters also address the question of the future for bird and plant communities in Australia, and suggest management strategies for their conservation.

Perhaps the overriding impression gained from the book is that in attempting to answer many questions about bird-plant relationships, it raises many more, as would be expected in such a youthful field of research. The reader is provided with a kaleidoscope of bird-plant interactions yet to be investigated, and is given many suggestions as to the directions that future research may take.

The literary style adopted by most of the thirteen authors is somewhat more expansive and descriptive than would appear in a scientific journal, and the book is liberally illustrated with tables, figures and colour plates, so it should be an informative text for amateur ornithologists, botanists and ecologists as well as for the scientific community. The book has been well-produced, the layout is good, and the printing excellent; a minor criticism is that many of the chapter sub-headings are larger and bolder than is aesthetically necessary. It is priced reasonably, and is a creditable addition to the series of Handbooks of the Flora and Fauna of South Australia. I recommend it to anyone interested in ecology and conservation.

P. HORTON, South Australian Museum, North Terrace, Adelaide, South Australia 5000. *Rec. S. Aust. Mus.* 22(2): 189, 1988.

NGURUNDERI: A NGARRINDJERI DREAMING[1]

The South Australian Museum has for several years been developing an exhibition depicting aspects of the Aboriginal culture of the Lower Murray region of South Australia. Central to the religious beliefs of the people in this region was the Dreaming ancestor Ngurunderi and the story of the creation of the Murray River and many other geographical features in the Lower Murray and Coorong areas. The exhibition incorporates as a central theme the Dreaming of Ngurunderi. As an introduction to the exhibition, the South Australian Museum, in association with the South Australian Film Corporation, Pepper Studios and the Ngarrindjeri Community have produced a short film entitled 'Ngurunderi: A Ngarrindjeri Dreaming'. After several years of planning it was finally completed in 1987 and was launched early in 1988. The film won a silver award in the education/social studies category at the New York World Film and Television Festival. It also won a gold award for camera work from the Australian Society of Cinematographers. Since the launch it has been screened continuously in the introductory area to the planned exhibition. This was the Museum's intended function for the film, with perhaps the possibility of its use by the South Australian Education Department. The South Australian Film Corporation, which holds the copyright of the film, are trying to market it as widely as possible and copies are presently available from the Film Corporation or through the South Australian Museum shop.

A number of accounts of the Ngurunderi Dreaming were recorded by anthropologists, missionaries and other non-Aboriginal commentators including Cawthorne, Taplin, Meyer, Smith, Berndt, and Tindale. Most relate only to a small segment of the Dreaming, usually focusing upon Ngurunderi's exploits in one particular area. Professor Ronald Berndt's version (1940) is the most detailed published account and it is upon this that the Museum's film is mainly based. Dr Norman Tindale, the other anthropologist to have worked extensively in the area, also collected lengthy accounts, but these are yet to be fully published. His one brief published account (Tindale & Pretty 1978) differs in certain details from that of Berndt. Both these anthropologists worked with Aboriginal people from different groups in the region: Berndt's main source of information was Albert Karloan, an initiated man of the Yaralde people; Tindale's primary source was Clarence Long, an initiated man from the Tangane people. This may be the reason for the variation in the two accounts. The people in each Ngarrindjeri group would have known in most detail the section of the Ngurunderi Dreaming that related to their own region. This phenomenon still exists today and those in the Ngarrindjeri community who have heard about Ngurunderi from the old people usually know something of the section which relates to the areas associated with their families.

In several of the published accounts, Ngurunderi's epic journey appears to have started in the Darling Junction area of the River Murray and continued down the Murray to the Lakes. Some Ngarrindjeri people today see this as providing evidence that Ngarrindjeri territory, before the arrival of the Europeans, stretched as far as the Darling region. In Berndt's version, Ngurunderi chases the giant cod, **ponde**, into Lake Alexandrina and with the help of his brother-in-law Nepele, the cod is speared and cut into many pieces. He changes each piece into one of the present-day species of freshwater fish inhabiting the area. George Trevorrow, a Ngarrindjeri man with a Coorong background, knows another version of this part of the Dreaming. He describes a different location for the cutting up of the cod and includes the creation of saltwater fish such as the mulloway. A combination of this and Berndt's version is used for this incident in the film. Henry Rankine, another Ngarrindjeri man who provided details not available in the Berndt version of the Dreaming, has a connection through his father with the Lower Murray area and the northern shores of Lake Alexandrina. He supplied some detail about Ngurunderi's use of smoke signals and this was also included in the film.

According to Berndt's account, Ngurunderi's journey continued from the Lakes area, down the Coorong to Kingston. During this part of the Dreaming, his runaway wives become a central feature of the events. At Kingston, Ngurunderi fought with an evil sorcerer called Parampari. He killed Parampari and burnt his body, which changed into the Granites near Kingston. Ngurunderi then pursued his wives back towards the Murray mouth, crossed it and travelled around Encounter Bay. Along this coast he created many of the islands, including Granite Island. I have not spoken with any Ngarrindjeri people who know details of the Encounter Bay section of the Ngurunderi Dreaming. This is to be expected, given the rapid occupation of this area by the British and the impact that this had on the culture of the local Ngarrindjeri group, the Ramindjeri. Ngurunderi caught up with his wives, who had broken several Ngarrindjeri laws and drowned them by flooding the land between the mainland and Kangaroo Island — their bodies became 'The Pages'. He crossed

Backstairs Passage to Kangaroo Island where he entered the spirit world. According to Ngarrindjeri belief, Ngurunderi established many laws and when someone dies the spirit follows Ngurunderi to Kangaroo Island and from there into the spirit world. Today Ngarrindjeri people still bury their dead with the head facing towards Kangaroo Island in the west. The association of this practice with Ngurunderi's laws is now only becoming widely known through the greater availability of the published versions of the Ngurunderi Dreaming. It is also due, though, to the activities of the South Australian Museum, its exhibition and the inclusion of this Dreaming story in new courses being developed by the South Australian Education Department.

As previously mentioned, most of the available accounts of the Ngurunderi story are fragmentary. One of the earliest examples is provided by the missionary H.A.E. Meyer (1846). Here 'Nurrunduri' is described as controlling the life of the moon, who was a woman. When she becomes too thin he orders her to be driven away to eat roots and so recuperate. Meyer's version of the cutting up of the cod and the creation of the fish from the pieces varies considerably from Berndt's account. He says Pungngane caught a **ponde** and divided it into pieces, each becoming a cod. Strangely enough he threw them into the sea. The association with saltwater is to be expected here as Meyer's informants were Ramindjeri people and therefore predominantly coastal dwellers. Tindale (1935) says that Pungngane is the equivalent of Nepele. Another early version of the Dreaming story was recorded by W.A. Cawthorne in the early days of British settlement and published in 1926. Here 'Ooroondovil' (Cawthorne's spelling) is described as the 'first great spirit', who made the land, when all that existed was water. This is very different from Berndt's account of the Dreaming story in which Ngurunderi appears in the later phase of the Dreaming, after the land, sea and other basic forms have already been created. However, there are some similarities and interestingly, Cawthorne says that after leaving Kangaroo Island, Ooroondovil '. . . went on westward, where he still lives, though by this time a very old man, and has taught the Europeans the use of firearms, how to make clothes, etc.' (Cawthorne 1926: 26).

During research for the main exhibition and for the film, I worked with a number of Ngarrindjeri people who were at least partly familiar with the Dreaming of Ngurunderi. All knew only fragments of the detailed Dreaming story that must have once existed. One interview I had with a non-Aboriginal, former riverboat captain, Don Ledo, also provided some interesting information. As a child he grew up on the Murray and he spent much of his time with Aboriginal friends. He remembers listening to an old Aboriginal man telling, or rather acting out, the Dreaming story of Ngurunderi. George Taplin, the missionary who established Point McLeay settlement, records in his diary a corroboree he witnessed which incorporated song and dance and, as he discovered, concerned Ngurunderi (Taplin 1873, 1879). There would have been many such corroborees concerning Ngurunderi. When I first asked Don Ledo whether he knew anything about Ngurunderi, it took him a few minutes to recognise my initial crude attempt at pronunciation. However, he soon worked out that I meant, 'Ngoorroonderree' (primary stress on the first syllable, 'oo' as in 'book', and the 'rr' trilled), as he pronounced it. Of the several Ngarrindjeri people whom I have heard use the word Ngurunderi, most employ the same pronunciation as Ledo. The Ngarrindjeri spoke several different dialects and this probably accounts for some of the variations. For instance, some Coorong people pronounce the word with a 'u' sound as in 'but'.

Initially, missionary George Taplin used the word 'Ngurunderi' as a convenient translation for God. He wanted to use the local language and a modified version of the Dreaming as a tool in the conversion of the Ngarrindjeri to Christianity. However, he soon discovered that Ngurunderi was responsible for many customs with which he was loath to associate his God. He subsequently set about dissuading the use of Ngurunderi as the equivalent for his concept of the Christian God. There are a number of historical examples of his lack of success in this endeavour and a few Ngarrindjeri people have continued to equate Ngurunderi with God. For example, this is the philosophy of the Ngarrindjeri church at Meningie, on Lake Albert. When consultations regarding the making of the film were started, I was told by various people including the Chairman of Point McLeay, Henry Rankine, that I would have to speak to Mrs Lola Sumner, as she was one of the most important and knowledgeable old people in the Ngarrindjeri community. She approved of the idea of the Museum making a film of the Ngurunderi Dreaming. She also pointed out that Ngurunderi was the Ngarrindjeri way of saying 'God'. Her pronunciation of the word was the same as Ledo's and it was on her authority that we used it in the film. Mrs Sumner, who is now deceased, was recognised in the Ngarrindjeri community for her excellent knowledge of the language.

The main Ngarrindjeri contributors to the development of the film's script were Henry Rankine, George Trevorrow, and Harvey Karpany. However, most of the detail used was from Berndt's version which was recorded in the late 1920s and early 1930s from information supplied by Ngarrindjeri people such as Albert Karloan. It was decided early during the film's planning that, ideally, a Ngarrindjeri narrator and Ngarrindjeri actors were required. Henry Rankine was selected by the South Australian Film

Corporation to be the narrator and the actors for the film were chosen from the Point McLeay and Meningie Aboriginal communities. The selected locations were as close as possible to the actual places mentioned in the Dreaming. The actors were: Henry Rankine jnr. (Ngurunderi), Maxwell Rankine (Nepele), Fred Sumner (Parampari), Susan Rankine (Wife) and Margaret Rankine (Wife). It was felt necessary and agreed upon by Ngarrindjeri people that the actors be of a dark skin colouring for the authenticity of the film. From the beginning it was also decided that identifiable facial shots should not be used in the film, in an attempt to retain a mystique about the identity of Ngurunderi.

For the film, we paid particular attention to detail in the items of material culture used. We highlighted, as much possible, the differences between the southern Australian Aboriginal cultures and peoples and those of the desert and the north. The baskets and mats used in the film were made by Yvonne Koolmatrie, Ellen Trevorrow and Glenda Rigney. These women have continued the Ngarrindjeri basketry tradition in that the technique and materials they use have not changed since at least 1836.

Prior to the final version of the film being released a seminar was organised for the Ngarrindjeri community during which they could view the film and comment on its development. The progress of the exhibition itself was also discussed. About two hundred Ngarrindjeri people attended this seminar and the response to the film was very encouraging. The film has certainly been successful in its role as an introduction to the Ngarrindjeri exhibition and it will also have applications outside the Museum in areas such as education and tourism. Its production, however, required a complicated series of consultations with members of the Ngarrindjeri community, particularly given the Museum's inexperience in the area of film-making. However, the finished product was worth the effort, due in no small way to the sensitive handling of the subject by Pepper Studios. Many opportunities exist for similar films to be made in the future and perhaps the education system should be seeking funding for their production. In the final analysis, however, the film 'Ngurunderi' illustrates the value for museums, of a close, co-operative, working relationship with the Aboriginal community and the value of film as a medium for effectively educating the wider Australian public about Aboriginal culture.

Endnote

1. When the British first arrived in South Australia, the peoples of the Lower Murray were identified by a large number of local clan and language-group designations. Today most of the local people from this area identify themselves as Ngarrindjeri people. The Ngarrindjeri community numbers several thousand people and is spread throughout the Murray River and south-east region of the state.

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WATTS, C.H.S. 1988. *Rec. S. Aust. Mus.* **22** (1): 21-28.

p. 22 — Lower caption should read:
FIGURES 7-13. 7, lateral view of aedeagus of *H. alastairi*; 8, lateral view of aedeagus and paramere of *H. gibbus*; 9, dorsal view of aedeagus of *H. gibbus*; 10, ditto *H. alastairi*; 11, lateral view of aedeagus and paramere of *H. fuscatus*; 12, dorsal view of aedeagus of *H. fuscatus*.

p. 27 — Start of 'Remarks' should read:
Does not appear to be as common as *H. gibbus*, nor as widespread. I have been unable to separate this species from *H. gibbus* except by the male aedeagus, which is narrow and sinuate, but broad in *H. gibbus*.

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SKULL MORPHOMETRICS OF *LASIORHINUS LATIFRONS* (OWEN 1845) (MARSUPIALIA: VOMBATIDAE)

G. G. SCOTT, K. C. RICHARDSON & C. P. GROVES

SCOTT, G. G., RICHARDSON, K. C. & GROVES, C. P. 1989. Skull morphometrics of *Lasiorhinus latifrons* (Owen, 1845) (Marsupialia: Vombatidae). *Rec. S. Aust. Mus.* 23(1): 1–5.

Skull morphometrics do not support the splitting of *L. latifrons* into two subspecies, one at each end of its geographic range. Measurements of wombat skulls from the Blanchetown region in the east of South Australia to Nullarbor Station, approximately 1000 km to the west, do not show any clinal variation. Analysis of wombat measurements from intermediate geographic locations show little variation of the homogeneity within *L. latifrons* over its entire geographic range.

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South Australian hairy-nosed wombat taxonomy began in 1845, when Owen (1845) exhibited the skull of a wombat at a meeting of the Zoological Society of London. He named the new species *Phascolomys latifrons*. Owen (1849) gave a more detailed account in the Society's transactions of 1849, but the wombat's external anatomy remained unknown. Twelve years later Angas (1861) suggested a conspecificity between Owen's species and a wombat at that time living in the Adelaide Zoo. This suggestion was rejected by Gray (1863) because Owen had based his description of *P. latifrons* on a single skull. Gray subsequently created a new species, *P. angassii*, for the Adelaide Zoo wombat. Gray (1863) also rejected Gould's (1863) published plates of what he thought Owen's *P. latifrons* might look like based on a large common wombat skin sent to the British Museum from South Australia. Gray named the skin *P. setosus*. Subsequently Gould (1863) named the hairy-nosed species, featured in another of his plates, *P. lasiorhinus*. Gray (1863) also disagreed with Gould's *P. lasiorhinus* for he added the name *Lasiorhinus m'coyi* to the taxonomic miasma. South Australian hairy-nosed wombat taxonomy was finally resolved when the skull of the animal described by Angas (1861) was shown to be a specimen of *P. latifrons* Owen (Murie 1867).

A distinction between the hairy-nosed wombat and the common wombat was made by Wood Jones (1924) who split the genus *Phascolomys* into *Lasiorhinus* Gray 1863, the hairy-nosed wombat, and *Vombatus* Geoffroy 1803, the common wombat, on the basis of skeletal and external differences.

South Australian hairy-nosed wombat taxonomy was resurrected over a century later when Crowcroft (1967) hinted that there might be more than one subspecies of *L. latifrons*, one at each end of its known geographic range i.e. Portee in the east, and Nullarbor Station in the west. Although presenting an important zoogeographic question, no attempt has since been made to resolve Crowcroft's observation.

Materials and Methods

Specimens

Skulls of *Lasiorhinus latifrons* from their entire geographic range in South and Western Australia were examined in the collections of the South Australian Museum and British Museum (Natural History). Additional specimens were collected at Blanchetown, Roonka and Swan Reach in South Australia.

Measurements

Although both adult and juvenile specimens were examined for this study, osteological measurements were made, by vernier calipers, on adults only i.e. on skulls in which all cranial sutures were closed, and all teeth fully erupted.

Skull Measurements

1. Skull length; distance from the most rostral point of the incisive bones to the most caudal point of the parietal bones.
2. Bitemporal breadth; distance across the temporal bones, rostral to the mastoid process and caudal to the squamous root of the zygomatic.
3. Frontal length; measured along the midline from the frontonasal suture to the coronal suture.
4. Bimalar breadth; distance across the malar bones opposite the maxilloincisive suture.
5. Nasal length; distance along the midline from the most rostral point of the nasals to their junction with the frontonasal suture.

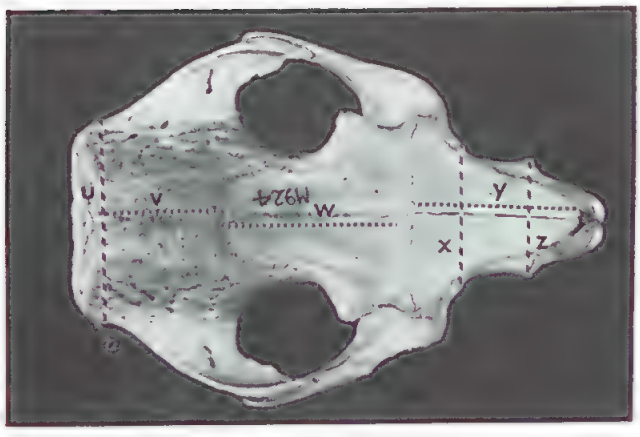

FIGURE 1. Some of the skull measurements used on the skulls of *L. latifrons*. This specimen was collected from Kyancutta, S.A. u, bitemporal breadth; v, length from the coronal suture to the lambdoidal suture; w, frontal length; x, bimalar breadth; y, nasal length; z, bi-incisive breadth.

6. Bi-incisive breadth; distance between the nares.
7. Bizygomatic breadth; distance across the skull between the lateral surfaces of the zygomatic bones.
8. Combined upper incisor alveolar breadth.
9. Upper diastema length.
10. Mandible length; distance from the most rostral point of the incisor alveoli to the most caudal point of the condyloid process.

Osteological terminology used is as in the 'Nomina Anatomica Veterinaria' (Habel *et al.* 1983).

Analysis

Student's *t*-test, 2-'sided' and bivariate regression analysis (Simpson *et al.* 1960), and Coefficient of Difference analysis (Mayr 1969) were used. As bivariate regression analysis showed no significant sexual dimorphism for any skull character, measurements of both sexes were combined.

Systematics

Lasiorhinus latifrons (Owen 1845)

1845 *Phascolomys latifrons* Owen. South Australia.
1863 *Phascolomys angassii* Gray. South Australia.
1863 *Phascolomys lasiorhinus* Gould. South Australia.
1863 *Lasiorhinus m'coyi* Gray. South Australia.

Holotype

Lasiorhinus latifrons, British Museum number 46.338, skull, subadult. South Australia. No specific location given.

Description

Cranium: frontals long; nasals short with straight tips; nasals bend before rostral surface of incisives; incisive process reduced to a tubercle; frontonasal suture has a rostrocaudal amplitude of 0.5–1.0 mm; cranial vault is convex; occiput at the nuchal crest is concave; there is no parietal pit; there is no process on the medial surface of the mandibular fossa.

Mandible: articular surface is short and does not overhang the inflected angle; rostral origin of the ascending ramus is opposite the third and fourth molar teeth; condyloid processs has a deep fossa on the rostral surface; masseteric fossa is shallow.

Dentition: premaxillary incisor, occlusal surface is short. Mandibular incisor, occlusal surface is elongate. Maxillary premolar, occlusal surface is elongate, there is a longitudinal mesiolingual groove approximately 1 mm wide. Mandibular premolar, occlusal surface is quadrate. Mandibular molars, have a shallow groove on the distal surface of the 1st molar and mesiovestibular surface of the 2nd, 3rd and 4th molars.

Distribution

The specimens were grouped on their geographic origin as coming from eastern, central and western regions. The eastern region included specimens from the Murray Valley and Yorke Peninsula. The central region had specimens from Eyre Peninsula and west of Lake Harris to Fowlers Bay. The western region consisted of specimens from Yalata to Caiguna extending north to the Transcontinental Railway (Marlow 1965, Lowry 1967, Wells 1968, Conquest 1969, Aitken 1971, McIlroy 1973).

Analysis

Metric differences

Pooled measurements for wombats from their eastern distribution differ from those from their western distribution. Using mean and range values in millimetres they are on average larger in skull length: 163.3 (149.6–175.6) *v.* 162.4 (150.5–175.7) and frontal length 63.0 (58.6–68.9) *v.* 59.9 (58.4–61.5).

Their mean values show their bimalar breadth to be 47.9 (41.5–54.0) *v.* 51.2 (45.6–55.9), bitemporal breadth 64.2 (57.2–70.7) *v.* 72.7 (67.5–78.3), bi-incisive breadth 38.3 (33.9–41.8) *v.* 39.2 (37.7–41.0), upper diastema length 38.3 (34.5–43.5) *v.* 39.7 (35.5–43.7) and mandible length 120.4 (111.2–128.7) *v.* 122.1 (113.2–129.0). The means of eastern wombats are all smaller.

Bivariate regression

On the basis of cranial characters (Figs 3–4), Nullarbor wombats generally have mean values larger than those of the eastern animals for bitemporal breadth relative to skull length.

FIGURE 2. Dorsal view of the cranium of male *L. latifrons* from (A) Blanchetown, and (B) Nullarbor Station. x, nuchal crest; y, cranial vault; z, arrowed, frontonasal suture.

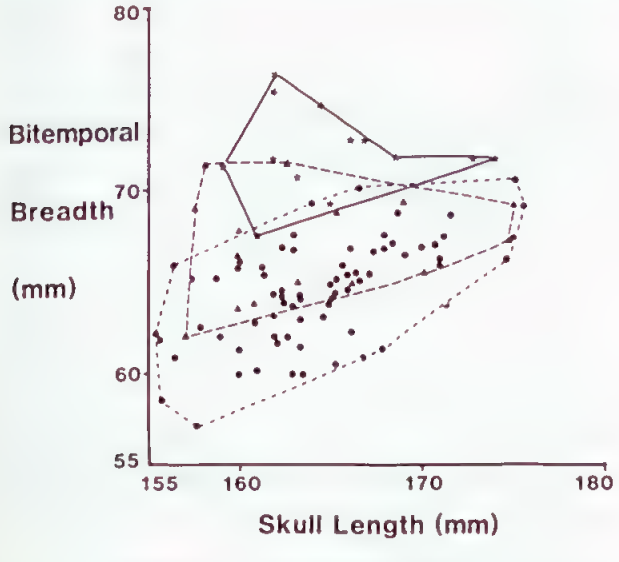

FIGURE 3. Bitemporal breadth relative to skull length of adult specimens of *L. latifrons*. (--●--), *L. latifrons* from locations at the eastern end of their range; (-▲-) from Yardea; (-★-) from the western end of their range.

Morphological differences

Frontonasal sutures are directed rostrally into the nasals in wombats from their eastern distribution, but are directed caudally into the frontals in wombats from their western distribution. Additionally in the eastern wombats the nuchal crest at its midsagittal region is slightly concave cf. deeply concave. Also the nuchal crest is level with parietals cf. raised above parietals.

Discussion

Although Crowcroft (1967) was able to distinguish Portee wombat crania from those from Nullarbor Station, and the present authors could in many instances separate the two populations by the shape of the cranial vault, these features were found to be unreliable as diagnostic characters. Indeed, this study found that approximately 23% of crania examined from their eastern distribution could be confused with those from their western distribution when using the frontonasal suture direction characteristic. There was also a 30% error when cranial vault shape was used.

Although the morphological differences are sufficiently great to invoke Mayr's (1969) 75% Rule, under which a population is deemed to be a subspecies when 75% of its members are distinguishable from all members of a previously recognised population, data from the few available wombat crania collected from their central distribution show intermediate features suggesting that the splitting of *L. latifrons* into two subspecies is premature.

Clinal variation is suggested by the gradual

TABLE 1. Skull measurements of adult *Lasiorhinus latifrons*. Values are in millimetres.
a, Mt Gambier; b, Portee, Blanchetown, Roonka and Swan Reach; c, Yorke Peninsula; d, Eyre Peninsula; e, Yardea; f, Fowler's Bay; g, Great Australian Bight; h, Nullarbor Station.

Geographic location		a	b	c	d	e	f	g	h
Skull length	n	1	80	4	2	20	—	1	53
	$\bar{x}$	163.4	163.3	162.0	174.9	161.3	—	163.1	162.4
	sd	0.00	5.87	2.50	0.00	6.35	—	0.00	5.78
Bimalar breadth	n	1	77	3	2	16	1	1	14
	$\bar{x}$	54.3	47.9	46.5	47	50.9	51.8	52.7	51.2
	sd	0.00	3.11	1.32	0.00	2.81	0.00	0.00	2.91
Bizygomatic breadth	n	1	76	3	1	20	1	1	52
	$\bar{x}$	116.8	120.2	114.9	130.7	120.4	128.3	126.0	120.4
	sd	0.00	4.34	4.95	0.00	6.11	0.00	0.00	4.64
Bitemporal breadth	n	1	77	4	2	16	—	1	13
	$\bar{x}$	64.1	64.2	62.8	68.4	66.2	—	70.7	72.7
	sd	0.00	2.86	1.51	0.00	3.57	—	0.00	2.88
Bi-incisive breadth	n	1	78	4	2	16	1	1	14
	$\bar{x}$	38.8	38.3	37.6	39.7	40.4	39.8	40.1	39.2
	sd	0.00	1.85	1.87	0.00	1.42	0.00	0.00	1.13
Nasal length	n	—	5	—	—	—	—	—	—
	$\bar{x}$	—	56.4	—	—	—	—	—	—
	sd	—	3.91	—	—	—	—	—	—
Frontal length	n	1	26	2	—	—	—	1	3
	$\bar{x}$	67.4	63.0	59.0	—	—	—	58.4	59.9
	sd	0.00	2.77	0.00	—	—	—	0.00	1.55
Combined upper incisor breadth	n	—	15	—	—	—	—	1	1
	$\bar{x}$	—	23.9	—	—	—	—	24.6	25.1
	sd	—	1.01	—	—	—	—	0.00	0.00
Upper diastema length	n	1	71	4	2	16	1	1	14
	$\bar{x}$	40.1	38.3	38.8	43.1	38.2	42.4	40.0	39.7
	sd	0.00	2.03	0.76	0.00	1.39	0.00	0.00	2.3
Mandible length	n	1	67	3	2	16	1	—	14
	$\bar{x}$	121.00	120.4	119.4	131.8	120.5	122.8	—	122.1
	sd	0.00	3.96	1.28	0.00	4.07	0.00	—	4.63

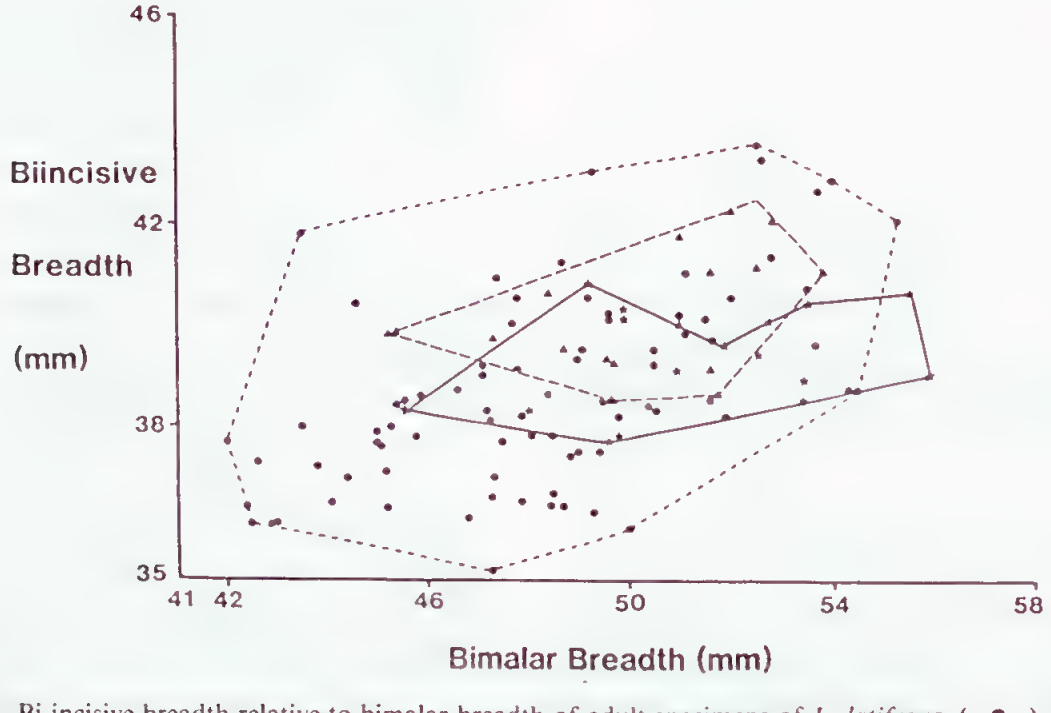

FIGURE 4. Bi-incisive breadth relative to bimalar breadth of adult specimens of *L. latifrons*. (--●--), *L. latifrons* from locations at the eastern end of their range; (-▲-) from Yardea; (-★-) from the western end of their range.

change in frontonasal suture shape and orientation. It is generally directed rostrally into the nasals in wombats from the eastern regions of their range; straight across the nasals in those from their central distribution; and directed caudally into the frontals in animals from the western reaches of their range (Crowcroft 1967). However, there is much variability evident within the entire wombat distribution.

Analysis of the available data for *L. latifrons* show the species to be morphologically homogeneous over the extent of its geographic range. This conclusion, however, does not exclude the possibility of genetic drift, hence morphological divergence occurring within, and between, the various disjunct populations.

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CHECKLIST OF FREE-LIVING MARINE NEMATODES FROM AUSTRALIA, MACQUARIE ISLAND AND HEARD ISLAND

PENELOPE GREENSLADE

GREENSLADE, PENELOPE 1989. Checklist of free-living marine nematodes from Australia, Macquarie Island and Heard Island. *Rec. S. Aust. Mus.* 23(1): 7–19.

A checklist is provided of all records of free-living marine nematodes from Australia together with the locality from which each was recorded and the relevant references. Species are listed using the current available name and 263 species are recorded here in 119 genera belonging to 38 families.

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The free-living marine nematode fauna of Australia has been little studied but recent collections have shown that it is extremely rich in species (H. Platt pers. comm., W. Nicholas unpubl. results). It is clear that there is a need for considerable work on the taxonomy of the group based on surveys of the fauna of different regions and habitats in Australia. Since most genera of marine free-living nematodes appear to be cosmopolitan in distribution, keys to genera produced overseas are useful and relevant to the Australian fauna. For instance pictorial keys published overseas by Tarjan (1980) and Platt & Warwick (1983) and a recently developed computer key devised by Tarjan are relevant. However these keys need to be given an Australian emphasis by the publication of records of genera from Australia and of lists of the genera likely to be found in different habitats. Consequently it was decided to collect all previously published records so that information on the taxa already known was easily accessible. Only those species collected in or near Australian coasts have been included and no attempt has been made to list species from other Antarctic, Subantarctic or Pacific sublittoral localities.

The earliest collections were described by Cobb (1983, 1894, 1898, 1920), Irwin-Smith (1917) and Allgen (1927, 1929, 1930, 1951a, b). More recently Mawson (1953, 1957, 1958), and Inglis (1967, 1969, 1970, 1971) have worked in Australia on the fauna. Further species have been described by Decraemer (1974; 1975a, b, c, d, e; 1976; 1977 a, b; 1978 a, b, c; 1979), Decraemer & Coomans (1978 a, b), Nicholas & Stewart (1984), Stewart & Nicholas (1986) and Riemann (1986), while Hodda & Nicholas (1985, 1986a, b) have published new records of genera in most cases without identifying to species. A list of the type species in the South Australian Museum has been published by Smales (1983) although this list is not comprehensive.

The first checklist of marine free-living nematodes for Australia was produced by Johnston (1938) who listed 49 species in 33 genera and 20 families. He recorded some genera and families without described species from Australia. In the present list 263 species are recorded belonging to 119 genera in 38 families. This is only a slightly more than the number of species and genera collected from a single locality off the Tasmanian coast which contained many undescribed species and some new genera (H. Platt & K. Martin pers. comm.) so that it is certain that this list represents only a small part of the whole Australian fauna.

The recent revision of the higher classification of Lorenzen (1981) has been followed and the families are listed in the order in which he places them. For the Monhysteridae, the combinations of Jacobs (1987) have been followed. Species are listed in alphabetical order within genus, and genera are placed in alphabetical order within each family. A species is listed under the most acceptable recent name and a synonomy and list of names in earlier usage is provided if this relates to publications on Australian faunas. It was not considered necessary to give a complete world synonymy as this can be found in Gerlach & Riemann's (1973) exhaustive treatment of the group. Australian distribution records are given in full where known, together with a reference to the relevant publication. The record of Hyman I. quoted by Decraemer is believed to be Hayman Island and has been changed to the correct spelling throughout. Also there are inconsistencies in the spelling of Nymphe or Nymph I.; the former spelling is used here. Records of species in Australia published here for the first time are marked with an asterisk. It must be noted also that Allgen's records should be treated with caution because his descriptions and identifications are in some instances unreliable and little material was retained. Non-Australian records have not been

included since they are available for records up to 1973 in Gerlach & Riemann (1984) and species described since that date are, probably without exception, only known from Australia.

All species included in the list are free-living and either from marine or brackish habitats. Records of genera without described species in Australia are given at the end of the species list.

Checklist

Adenophorea

Chromadoridae

Actinonema longicaudatum (Steiner 1918)
Lizard I. Q., Decraemer & Coomans 1978a, b.

Atrochromadora denticulata Wieser & Hopper 1967
Lizard I. Q., Decraemer & Coomans 1978a; Davies Reef Q., Alongi 1986.

Atrochromadora microlaima (de Man 1889)
= *Chromadora microlaima* de Man 1889
= *Chromadorina microlaima* (de Man 1889).
Tas., Allgen 1927; Port Jackson N.S.W., Allgen 1951a.

Atrochromadora parva (de Man 1893)
= *Spiliphera parva* de Man 1893.
Tas., Allgen 1927. (Tasmanian record not in Gerlach & Riemann 1973.)

Austranema alii (Murphy 1965)
Shark Bay W.A., Inglis 1969.

Austranema pectinatum (Wieser & Hopper 1967)
Lizard I. Q., Decraemer & Coomans 1978a.

Chromadora macrolaima de Man 1889
= *Chromadorina macrolaima* (de Man 1889).
Tas., Allgen 1927.

Chromadora macrolaimoides Steiner 1915
Tas., Allgen 1927. Lizard I. Q., Decraemer & Coomans 1978a.

Chromadora nudicapitata Bastian 1865
= *Chromadora siciliana* Wieser 1954.
Lizard I. Q., Decraemer & Coomans 1978a.

Chromadorella filiformis (Bastian 1865)
Port Jackson N.S.W., Allgen 1951a.; Davies Reef Q., Alongi 1986.

Chromadorina germanica (Butschli 1874)
= *Chromadora minor* Cobb 1894.
Port Jackson N.S.W., Cobb 1894.

Chromadorina pacifica (Allgen 1947)
= *Chromadora pacifica* Allgen 1947.
Port Jackson N.S.W., Allgen 1951a.

Chromadorita minor (Allgen 1927)
= *Hypodontolaimus minor* Allgen 1927.
Tas., Allgen 1927.

Dichromadora apapillata Timm 1961
Lizard I. Q., Decraemer & Coomans 1978a.

Dichromadora geophila (de Man 1876)
Lizard I. Q., Decraemer & Coomans 1978a.

Euchromadora eileenae Inglis 1969
Radar Reef, Strickland Bay, Rottnest I., Shark Bay, Cheyne Beach, nr Albany W.A., Inglis 1969.

Euchromadora striata (Eberth 1963)
Rottnest I., nr Albany, Cape Leeuwin W.A., Inglis 1969.

Graphonema georgei Inglis 1969
Albany W.A., Inglis 1969.

Graphonema vulgare (vulgaris ?) Cobb 1898
Australian coasts N.S.W., Vic., Cobb 1898.

Graphonema amokurae (Ditlevsen 1921)
= *Euchromadora amokurae* (Ditlevsen 1921).
Port Jackson N.S.W., Allgen 1951a.

Neochromadora apud tecta Gerlach 1951
Lizard I. Q., Decraemer & Coomans 1978a; Davies Reef Q., Alongi 1986.

Neochromadora wallini (Allgen 1927)
= *Chromadora wallini* Allgen 1927.
Tas., Allgen 1927.

Parapinnanema wilsoni Inglis 1969
Cape Leeuwin, Geographe Bay W.A., Inglis 1969.

Prochromadorella conicaudata (Allgen 1927)
= *Chromadora conicaudata* Allgen 1927.
Tas., Allgen 1927.

Prochromadorella ditlevseni (de Man 1922)
Lizard I. Q., Decraemer & Coomans 1978a.

Prochromadorella paramucrodonta (Allgen 1929)
= *Chromadora paramucrodonta* Allgen 1929.
Macquarie I., Allgen 1929; Port Jackson N.S.W., Allgen 1951a.
Lizard I. Q., Decraemer & Coomans 1978a; Davies Reef Q., Alongi 1986.

Ptycholaimellus lizardiensis Decraemer & Coomans 1978
Lizard I. Q., Decraemer & Coomans 1978a, b.

Ptycholaimellus slacksmithi (Inglis 1969)
= *Hypodontolaimus slacksmithi* Inglis 1969.
Shark Bay, Cowaramup Bay W.A., Inglis 1969.

Spiliphera dolichura de Man 1893
Port Willunga, Brighton S.A., Mawson 1957.

Spilophorella campbelli Allgen 1928.
Port Jackson N.S.W., Allgen 1951a.

Spilophorella paradoxa (de Man 1888)
Lizard I. Q., Decraemer & Coomans 1978a; Davies Reef Q., Alongi 1986.

Spilophorella tasmaniensis Allgen 1927
Tas., Allgen 1927.

Steineridora loricata (Steiner 1916)
= *Spiliphera loricata* Steiner 1916 (or *Spilophora* Johnston 1938)
= *Euchromadora loricata* (Steiner 1916).
Tas., Allgen 1927; Port Jackson N.S.W., Allgen 1951a.

Ethmolaimidae

Ethmolaimus multipapillatus Paramonov 1926
Lizard I. Q., Decraemer & Coomans 1978a.

Neotonchidae

Neotonchus apud melotridus Wieser & Hopper 1966
Lizard I. Q., Decraemer & Coomans 1978a.

Cyatholaimidae

Acanthonchus viviparus Cobb 1920
= *Seuratiella pedroensis* Allgen 1947.
Port Jackson N.S.W., Allgen 1951a.

Longicyatholaimus heterurus (Cobb 1898)
= *Cyatholaimus heterurus* Cobb 1898.
Port Jackson N.S.W., Cobb 1898.

Longicyatholaimus minor (Cobb 1898)
= *Cyatholaimus minor* Cobb 1898
Port Jackson N.S.W. Cobb 1898.

Longicyatholaimus trichurus (Cobb 1898)
= *Cyatholaimus trichurus* Cobb 1898.
Port Jackson N.S.W., Cobb 1898.

Metacyatholaimus brevicollis (Cobb 1898)
= *Cyatholaimus brevicollis* Cobb 1898.
Port Jackson N.S.W., Cobb 1898.

Paracanthonchus caecus (Bastian 1865) (as *coecus in* Allgen 1951a)
Port Jackson N.S.W., Allgen 1951a.

Paracanthonchus cheynei Inglis 1970
Cheyne Beach, Radar Reef, Rottnest I. W.A., Inglis 1970.

Paracanthonchus hartogi Inglis 1970
Shark Bay W.A., Inglis 1970.

Paracanthonchus kartanum (Mawson 1953)
= *Harveyjohnstonia kartanum* Mawson 1953.
Pennington Bay, Kangaroo I. S.A., Mawson 1953; Cheyne Beach, Goode Beach, Hall's Head, Bunker Bay W.A., Inglis 1970.

Paracanthonchus margaretae Inglis 1970
Cheyne Beach, Windy Harbour, Bunker Bay, Cape Naturalist W.A., Inglis 1970.

Paracanthonchus parahartogi Decraemer & Coomans 1978
Lizard I. Q., Decraemer & Coomans 1978a, b.

Paracanthonchus paramacrodon Allgen 1947
Port Jackson N.S.W., Allgen 1951a.

Paracyatholaimus exilis (Cobb 1898)
= *Cyatholaimus exilis* Cobb 1898.
Port Jackson N.S.W., Cobb 1898.

Paracyatholaimus proximus (Bütschli 1874)
= *Cyatholaimus proximus* Bütschli 1874.
Tas., Allgen 1927.

Praeacanthonchus cygnis Inglis 1970
Woodman's Point, Freemantle W.A., Inglis 1970.

Xyzzors inglisi Wieser & Hopper 1967
Lizard I. Q., Decraemer & Coomans 1978a.

Selachinematidae = Choniolaimidae

Halichoanolaimus australis Cobb 1898
Port Jackson N.S.W., Cobb 1898.

Halichoanolaimus ovalis Ditlevsen 1921
Edithburg S.A, Mawson 1957.

Halichoanolaimus quattuordecimpapillatus Chitwood 1951
Lizard I. Q., Decraemer & Coomans 1978a, b.

Halichoanolaimus robustus (Bastian 1865)
Outer Harbour, Port Adelaide S.A., Mawson 1957.

Desmodoridae

Acanthopharynx distechei Decraemer & Coomans 1978
Lizard I. Q., Decraemer & Coomans 1978a, b.

Desmodora (Pseudochromadora) cazca Gerlach 1956
Hunter R., Fullerton Cove N.S.W, Hodda & Nicholas 1985, 1986a, b.

Desmodora (Croconema) cincta (Cobb 1920)
Lizard I. Q., Decraemer & Coomans 1978a.

Desmodora (Zalonema) megalosoma Steiner 1918
Lizard I. Q., Decraemer & Coomans 1978a.

Laxus longus Cobb 1894
Port Jackson N.S.W., Cobb 1894.

Metachromadora (M.) clavata Gerlach 1957
Lizard I. Q., Decraemer & Coomans 1978a.

Onyx apud perfectus Cobb 1891
Lizard I. Q., Decraemer & Coomans 1978a.

Paradesmodora campbelli (Allgen 1932)
Lizard I. Q., Decraemer & Coomans 1978a; Davies Reef Q., Alongi 1986.

Pseudonchus jenseni Murphy 1964
Bobbin Head N.S.W., Murphy 1964.

Spirinia (S.) laevioides Gerlach 1963
Lizard I. Q., Decraemer & Coomans 1978a.

Spirinia similis (Cobb 1898)
= *Spira similis* Cobb 1898.
Port Jackson N.S.W., Cobb 1898.

Draconematidae

Draconema falcatum (Irwin-Smith 1918)
= *Chaetosoma falcata* Irwin-Smith 1918.
Sydney and environs N.S.W., Irwin-Smith 1918.

Draconema haswelli (Irwin-Smith 1918)
= *Chaetosoma haswelli* Irwin-Smith 1918.
Sydney and environs N.S.W., Irwin-Smith, 1918.

Notochaetosoma cryptocephalum Irwin-Smith 1918
Sydney and environs N.S.W., Irwin-Smith 1918.

Notochaetosoma tenax Irwin-Smith 1918
Sydney and environs N.S.W., Irwin-Smith 1918.

Microlaimidae

Acanthomicrolaimus jenseni Stewart & Nicholas 1987
Broulee beach N.S.W. Stewart & Nicholas 1987.

Microlaimus problematicus Allgen 1932
Lizard I. Q., Decraemer & Coomans 1978a.

Microlaimus capillaris Gerlach 1957
Clyde River N.S.W. Jensen (in press).

Leptolaimidae
Camacolaimus exilis (Cobb 1920)
Lizard I. Q., Decraemer & Coomans 1978a.
Paraphanolaimus anisitsi (Daday 1905)
Lizard I. Q., Decraemer & Coomans 1978a

Plectidae
Plectus longicaudatus Butschli 1873
Lizard I. Q., Decraemer & Coomans 1978a.

Teratocephalidae
Euteratocephalus palustris (De Man 1880)
Lizard I. Q., Decraemer & Coomans 1978a.

Monhysteridae
Geomonhystera australis (Cobb 1893)
=*Monhystera australis* Cobb 1893.
Port Jackson N.S.W., Cobb 1893.
Monhystrella gracilis Khera 1966
=*Monhystrella apud gracilis* Khera 1966.
Lizard I. Q., Decraemer & Coomans 1978a.
Monhystrella marina Timm 1964
Lizard I. Q., Decraemer & Coomans 1978a.
Thalassomonhystera diplops (Cobb 1894)
=*Monhystera diplops* Cobb 1894.
Port Jackson N.S.W., Cobb 1894.
Thalassomonhystera tasmaniensis (Allgen 1927)
=*Monhystera tasmaniensis* Allgen 1927.
Tas., Allen 1927.

Xyalidae
Daptonema australis (Allgen 1951)
=*Theristus australis* Allgen 1951, *sp. inq.* Lorenzen 1977.
Port Jackson N.S.W., Allgen 1951a.
Daptonema lata (Cobb 1894)
=*Cylindrotheristus latus* (Cobb 1894)
=*Monhystera lata* Cobb 1894, *sp. inq.* Lorenzen 1977.
Port Jackson N.S.W., Cobb 1894.
Daptonema setosa (Bütschli 1874)
=*Mesotheristus setosus* Bütschli 1874, syn. Lorenzen 1977
=*Monhystera gracillima* Cobb 1894.
Neutral Bay, Port Jackson N.S.W., Cobb 1894.
Rhynchonema cinctum Cobb 1920
Davies Reef Q., Alongi 1986.
Steineria apud ampullacea Wieser & Hopper 1967
Lizard I. Q., Decraemer & Coomans 1978a.
Steineria pulchra Mawson 1957
Outer Harbour, Encounter Bay S.A., Mawson 1957.
Steineria setosissima (Cobb 1894)
=*Monhystera setosissima* Cobb 1894.
Port Jackson N.S.W., Cobb 1894.
Theristus brevicollis (Cobb 1894)
=*Monhystera brevicollis* Cobb 1894.
Port Jackson N.S.W., Cobb 1894.
Theristus (Penzancia) flevensis Stekhoven 1935
Lizard I. Q., Decraemer & Coomans 1978a; Davies Reef Q., Alongi 1986 *lapsus flavis.*
Theristus interstitialis Warwick 1970
Fullerton Cove, Hunter River N.S.W., Hodda & Nicholas 1985, 1986a, b.
Theristus macquariensis (Allgen 1929)
=*Monhystera macquariensis* Allgen 1929, *sp. incertae sedis* Jacobs 1987.
Macquarie I. Allgen 1929.
Theristus (Penzancia) metaflevensis Gerlach 1955
Lizard I. Q., Decraemer & Coomans 1978a.
Theristus pacificus (Johnston 1938)
=*Monhystera pacifica* Johnston 1938
=*Monhystera australis* Cobb 1984.
Port Jackson, N.S.W., Cobb 1893.
Theristus quadripapillatus Decraemer & Coomans 1978
Lizard I. Q., Decraemer & Coomans 1978a, b; Davies Reef Q., Alongi 1986.

Sphaerolaimidae
Sphaerolaimus hirticollis Cobb 1898
Port Jackson N.S.W., Cobb 1898.
Sphaerolaimus papillatus Kreis 1929
Clyde R. Estuary N.S.W., Nicholas, Goodchild & Stewart 1987.

Desmoscolecidae
Desmolorenzenia cooleni Decraemer 1978
Low I. Great Barrier Reef Q. , Decraemer 1978b.
Desmolorenzenia crassicauda (Timm 1970)
Lizard I. Q., Decraemer 1977a.
Desmoscolex asetosus Decraemer 1975
800 m W of Lizard I., Nymphe I. Q., Decraemer 1975b.
Desmoscolex australicus Decraemer 1975
Yonge Reef Q., Decraemer 1975e.
Desmoscolex brevisetosus Decraemer 1974
Nymphe I., Lizard I. Q., Decraemer 1974.
Desmoscolex deconincki Decraemer 1975
Nymphe I, Yonge Reef Q., Port Jackson N.S.W., Decraemer 1975c.
Desmoscolex dimorphus Decraemer 1974
800 m W of Lizard I., Yonge Reef, Nymphe I. Q., Decraemer 1974a.
Desmoscolex falcatus Lorenzen 1972
Lizard I., Yonge Reef Q., Decraemer 1975e.
Desmoscolex geraerti Decraemer 1974
Yonge Reef Q., Decraemer 1974a.
Desmoscolex gerlachi Timm 1970
Lizard I. Q., Decraemer 1975e.
Desmoscolex granulatus Decraemer 1975
Yonge Reef, Lizard I. Q., Decraemer 1975a.
Desmoscolex laevis Kreis 1928
Nymphe I., Yonge Reef, Lizard I. Q., Decraemer 1975a, Decraemer & Coomans 1978a.

Desmoscolex leptus Steiner 1916
1 km behind Yonge Reef Q., Decraemer 1975b.
Desmoscolex longisetosus Timm 1970
Yonge Reef Q., Decraemer 1975c.
Desmoscolex membranosus Decraemer 1975
800 m W of Lizard I., Nymphe I., between One Tree I. and Wistari Reef Q., Decraemer 1975e.
Desmoscolex minutus Claparede 1863
Nymphe I. Q., Decraemer 1975a.
Desmoscolex nudus Chitwood 1951
800 m W of Lizard I., Decraemer 1975b.
Desmoscolex nymphianus Decraemer 1974
Nymphe I. Q., Decraemer 1974a.
Desmoscolex paraleptus Decraemer 1975
Yonge Reef Q., Decraemer 1975b.
Desmoscolex rudolfi Steiner 1916
Broulee N.S.W., det. W. Decraemer, 1986.
Desmoscolex yongei Decraemer 1975
Yonge Reef Q., Decraemer 1975e.

Meyliidae
Desmotimmia mirabilis (Timm 1961)
Yonge Reef, Lizard I., Three Isles, between Cairns and Hayman I. Q., Decraemer 1975d.
Quadricoma cobbi (Steiner 1916)
Between Cairns and Hayman I., Lizard I. Q., Decraemer 1978a.
Quadricoma crassicomoides Timm 1970
Lizard I., Nymphe I. Q., Decraemer 1978a.
Quadricoma freudenhammeri Decraemer 1977
800 m W of Lizard I. Q., Decraemer 1977b.
Quadricoma lizardiensis Decraemer 1977
800 m W of Lizard I. Q., Decraemer 1977b.
Quadricoma noffsingerae Decraemer 1977
Three Isles, Lizard I., between One Tree I. and Wistari Reef, between Cairns and Hayman I. Q., Decraemer 1977b.
Quadricoma papillata Decraemer 1977
800 m W of Lizard I., Three Isles, between Cairns and Hayman I. Q., Decraemer 1977b.
Quadricomoides alleni Decraemer 1976
Lizard I., Nymphe I., Three Isles, Yonge Reef Q., Decraemer 1976.
Quadricomoides coomansi Decraemer 1976
Between Cairns and Hayman I. Q., Decraemer 1976.
Quadricomoides pedunculata Decraemer 1976
Young Reef, between Cairns and Hayman I. Q., Decraemer 1976.
Prototricoma dherdei Decraemer 1978
Between Cairns and Hayman I. Q., Decraemer 1978b.
Tricoma aculeata Decraemer 1978c
Yonge Reef Q., Decraemer 1978c.
Tricoma absidata lizardiensis Decraemer 1979
Lizard I. Q., Decraemer 1979.
Tricoma allgeni Decraemer 1978
Yonge Reef Q., Decraemer 1978c.
Tricoma brevirostris (Southern 1914)
Yonge Reef Q., Decraemer 1978c.
Tricoma brevispicula Decraemer 1978
Yonge Reef Q., Decraemer 1978c.
Tricoma dimorpha Decraemer 1978
Yonge Reef Q., Decraemer 1978c
Tricoma fisheri Timm 1970
Between One Tree I. and Wistari Reef Q., Decraemer 1978c.
Tricoma goldeni Decraemer 1978
Yonge Reef Q., Decraemer 1978c.
Tricoma hoplostoma Decraemer 1978
Yonge Reef Q., Decraemer 1978c.
Tricoma hopperi australiensis Decraemer 1978
Yonge Reef Q., Decraemer 1978c.
Tricoma longispicula Decraemer 1978
Yonge Reef Q., Decraemer 1978c.
Tricoma pachycephala Decraemer 1978
800 m W of Lizard I. Q., Decraemer 1978c.
Tricoma platapophysa Decraemer 1978
Yonge Reef Q., Decraemer 1978c;
Broulee N.S.W., det. W. Decraemer 1986.
Tricoma riemanni Decraemer 1978
Yonge Reef Q., Decraemer 1978c.
Tricoma rostralis Decraemer 1978
Lizard I., Decraemer 1978c.
Tricoma septuaginta Stekhoven 1942
Yonge Reef Q., Decraemer 1978c.
Tricoma similis Cobb 1912
Yonge Reef Q., Decraemer 1978c.
Tricoma timmi Decraemer 1978
800m W of Lizard I., Yonge Reef Q., Decraemer 1978c.

Siphonolaimidae
Siphonolaimus purpureus (Cobb 1894)
=*Chromagaster purpurea* Cobb 1894.
North Arm, Port Adelaide S.A., Cobb 1894.

Linhomoeidae
Cryptolaimus pellucidus Cobb 1933
North Arm, Port Adelaide S.A. Cobb 1933.
Eleutherolaimus filicaudata (Allgen 1929)
=*Monhystera filicaudata* Allgen 1929, *sp. inq.* Jacobs 1987.
Davies Reef Q., Alongi 1986.
Megadesmolaimus uncinatus Gerlach 1963
Lizard I. Q., Decraemer & Coomans 1978a.
Metalinhomoeus setosus Chitwood 1951
Lizard I. Q., Decraemer & Coomans 1978a.
Paralinhomoeus macquariensis (Allgen 1929).
=*Linhomoeus macquariensis* Allgen 1929.
Macquarie I., Allgen 1929.
Terschellingia exilis Cobb 1898
Port Jackson N.S.W., Cobb 1898.
Terschellingia longicaudata de Man 1907
Hunter R., Fullerton Cove N.S.W., Hodda & Nicholas 1985, 1986a, b; Clyde R. Estuary

N.S.W., Nicholas, Goodchild & Stewart 1987; Lizard I. Q., Decraemer & Coomans 1978a, b; Davies Reef Q., Alongi 1986.

Axonolaimidae

Axonolaimus caudostriatus Boucher 1973
Lizard I. Q., Decraemer & Coomans 1978a; Davies Reef Q., Alongi 1986.

Nicascolaimus punctatus Riemann 1986
Kioloa Beach N.S.W., Riemann 1986.

Comesomatidae

Comesoma arenae Gerlach 1956
Bobbin Head N.S.W., Murphy 1964. (?syn. *'Comesoma simile' sensu* Wieser 1954, Gerlach & Riemann 1973).

Comesoma simile Cobb 1898 *lapsus similis*
Port Jackson N.S.W. Cobb 1898; Davies Reef Q. Alongi 1986 *lapsus similas.*

Paracomesoma dubium (Filipjev 1918)
Lizard I. Q., Decraemer & Coomans 1978a, b; Davies Reef Q., Alongi 1986.

Sabatieria heterura (Cobb 1898)
=*Comesoma heterura* Cobb 1898.
Port Jackson N.S.W., Cobb 1898; Davies Reef Q., Alongi 1986.

Sabatieria filicauda Allgen 1951
37°5' S, 150°05'E Allgen 1951a.

Sabatieria jubata (Cobb 1898)
=*Comesoma jubatum* Cobb 1898 *lapsus jubata.*
Port Jackson N.S.W., Cobb 1898.

Sabatieria wieseri Platt 1985
Clyde R. Estuary N.S.W., Nicholas, Goodchild & Stewart 1987.

Diplopeltidae

Araeolaimus elegans de Man 1888
=*Araeolaimus spectabilis* Ditlevsen 1921.
Tas., Allgen 1927.

Araeolaimus longicauda Allgen 1929
Port Jackson N.S.W., Allgen 1951a.

Enoplida

Enoplidae

Enoplus alpha Inglis 1971
Radar Reef, Stickland Bay, Rottnest I. W.A., Inglis 1971.

Enoplus heardensis Mawson 1958
Heard I., Mawson 1958.

Enoplus meridionalis Steiner 1921
=*Enoplus communis meridionalis* Steiner 1921.
Radar Reef, Stickland Bay, Rottnest I. W.A., Inglis 1971; Port Willunga S.A., Mawson 1953.

Enoplus michaelseni Linstow 1896
Macquarie I., Mawson 1958.

Enoplus micrognathus Allgen 1947
Port Jackson N.S.W., Allgen 1951 a.

Enoplus paralittoralis Wieser 1953
Heard I., Macquarie I., Mawson 1958.

Thoracostomopsidae

Enoplolaimus disasteri Allgen 1951 (listed as *Enoplus* by Allgen 1951a)
Disaster Bay, N.S.W., Allgen 1951a. *Incertae sedis* (Wieser 1953).

Epacanthion brevispiculosum Mawson 1958
Macquarie I., Mawson 1958.

Epacanthion georgei Inglis 1971
Cowaramup Bay W.A., Inglis 1971.

Mesacanthion gracilisetosum (Allgen 1930)
=*Enoplolaimus gracilisetosus* Allgen 1930.
Macquarie I., Allgen 1930; Wata Muri N.S.W., Mawson 1953.

Mesacanthion kerguelenense Mawson 1958
Heard I, Macquarie I., Mawson 1958.

Oxyonchus subantarcticus Mawson 1958
Macquarie I., Mawson 1958.

Anoplostomatidae

Anoplostoma campbelli Allgen 1932
Macquarie I., Mawson 1958.

Phanodermatidae

Paraphanoderma robynae Inglis 1971
Bunker Bay, Geographe Bay W.A., Inglis 1971.

Phanoderma campbelli Allgen 1928
Port Jackson N.S.W., Allgen 1951a; Macquarie I., Mawson 1958.

Phanoderma cocksi Bastian 1865
=*Phanoderma filipjevi* Micoletsky 1924.
Macquarie I., Mawson 1958.

Phanoderma ocellatum (Cobb 1920)
='*Phanoderma mediterraneum*' *nec* Micoletzky 1923 *sensu* Allgen 1947.
Lizard I. Q., Decraemer & Coomans 1978a; Port Jackson N.S.W., Allgen 1951a.

Phanoderma serratum Ditlevsen 1930
Goode Beach, Sarge Bay, Bunker Bay, Geographe Bay W.A., Inglis 1971.

Phanoderma wieseri Mawson 1956
Macquarie I., Mawson 1958.

Anticomatidae

Anticoma acuminata Eberth 1863
=*Anticoma similis* Cobb 1898.
Port Jackson N.S.W., Cobb 1898; Allgen 1951a. Outer Harbour, Brighton Beach S.A., Mawson 1957.

Anticoma campbelli Allgen 1932
Macquarie I., Mawson 1958.

Anticoma cobbi Inglis 1971
Hall's Head, Mandurah W.A. Inglis 1971.

Anticoma columba Wieser 1953

=*Anticoma australis* Mawson 1956.
Heard I., Macquarie I., Mawson 1958.
Anticoma lata Cobb 1898
Port Jackson N.S.W., Cobb 1898.
Anticoma subsimilis Cobb 1914
Heard I., Macquarie I., Mawson 1958.
Anticoma trichura Cobb 1898
Port Jackson N.S.W., Cobb 1898.
Platycomopsis gibbonensis (Mawson 1953)
=*Anticomopsis gibbonensis* Mawson 1953.
Port Gibbon N.S.W., Mawson 1953.

Ironidae
Thalassironus britannicus de Man 1889
Lizard I., Q., Decraemer & Coomans 1978a.
Thalassironus jungi Inglis 1964
Lizard I. Q., Decraemer & Coomans 1978a.
Trissonchulus oceanus Cobb 1920
Lizard I. Q., Decraemer & Coomans 1978a.

Leptosomatidae
Deontostoma antarcticum (Linstow 1892)
=*Thoracostoma antarcticum* (Linstow 1892).
Heard I., Macquarie I., Mawson 1958.
Deontostoma aucklandiae (Ditlevsen 1921)
=*Thoracostoma aucklandiae* Ditlevsen 1921.
Port Jackson N.S.W., Allgen 1951a.
Leptosomatides conisetosus Stekhoven & Mawson 1955
Macquarie I., Mawson 1958.
Leptosomatum arcticum Filipjev 1916
Heard I., Macquarie I., Mawson 1958.
Leptosomatum bacillatum (Eberth 1863)
Port Jackson N.S.W., Allgen 1951a.
Leptosomatum elongatum Bastian 1865
Port Jackson N.S.W., Allgen 1951a.
Leptosomatum micoletzkyi Inglis 1971
Cowaramup Bay W.A., Inglis 1971.
Leptosomatum sabangense Steiner 1915
=*Leptosomatum elongatum sabangese* Steiner 1915 (*lapsus sabangensis*).
Port Jackson N.S.W., Allgen 1951a.
Leptosomella phaustra Inglis 1971
Sarge Bay, Cape Leuwin W.A., Inglis 1971.
Thoracostoma angustifissulatum Mawson 1956.
Heard I., Macquarie I., Mawson 1958.
Thoracostoma anocellatum Stekhoven & Mawson 1955
Heard I., Macquarie I., Mawson 1958.
Thoracostoma arcticum Ssaveljev 1912
Macquarie I., Mawson 1958.
Thoracostoma australe Mawson 1953
Port Gibbon, Port Hacking, Wata Muri N.S.W., Mawson 1953.
Thoracostoma campbelli Ditlevsen 1921
Macquarie I., Heard I., Mawson 1958.
Thoracostoma coronatum (Eberth 1863)
37°5'S, 150°05"E.
Pseudocella panamaense (Allgen 1947)
=*Thoracostoma panamaense* Allgen 1947.
Macquarie I., S.A., Mawson 1958.
Pseudocella trichodes (Leuckart 1849)
=*Thoracostoma trichodes* (Leuckart 1849).
Port Jackson N.S.W., Allgen 1951a.

Oxystominidae
Halalaimus comatus Wieser 1953
Heard I., Macquarie I., Mawson 1958.
Halalaimus fletcheri Mawson 1958
Macquarie I., Mawson 1958.
Halalaimus macquariensis Mawson 1958
Macquarie I., Mawson 1958.
Nemanema campbelli (Allgen 1932)
=*Oxystomatina campbelli* Allgen 1932.
Macquarie I., Mawson 1958.
Oxystomina pellucida (Cobb 1898)
=*Oxystoma pellucidum* Cobb 1898 (*lapsus pellucida*).
Port Jackson N.S.W., Cobb 1898.

Oncholaimidae
Adoncholaimus crassicaudus Wieser 1953
Macquarie I., Mawson 1958.
Metoncholaimoides squalus Wieser,1953.
Macquarie I., Mawson 1958.
Metoncholaimus brevispiculum Mawson 1957
Brighton S.A., Mawson 1957.
Metoncholaimus pristiurus (Z. Strassen 1894)
Port River, S.A., Mawson 1953.
Mononcholaimus tasmaniensis Allgen 1927
=*Mononchölaimus elegans tasmaniensis* Allgen 1927 (the nominate species is recorded in *Viscosia* by Platt & Warwick 1983.)
Tas., Allgen 1927.
Oncholaimus brachycercus de Man 1889
Lizard I. Q., Decraemer & Coomans 1978a.
Oncholaimus dujardinii de Man 1876 (given as *dujardini* by Allgen 1951a)
Macquarie I., Mawson 1958; Port Jackson N.S.W., Allgen 1951a.
Oncholaimus leptos Mawson 1958
Heard I., Macquarie I., Mawson 1958.
Oncholaimus apud opisthonchus Filipjev 1927
Lizard I. Q., Decraemer & Coomans 1978a.
Oncholaimus paredron (Mawson 1958)
=*Oncholaimium paredron* Mawson 1958.
Macquarie I., Mawson 1958.
Oncholaimus paralangrunensis (Allgen 1947)
=*Viscosia paralangrunensis* Allgen 1947.
Port Jackson N.S.W., Allgen 1951a.
Oncholaimus viridis Bastian 1865
Tas., Allgen 1927; Port Jackson N.S.W., Allgen 1951a.
Pelagonema obtusicaudum Filipjev 1918 (given as *obtusicauda* by Allgen 1951a).
Port Jackson, Disaster Bay N.S.W., Allgen 1951a, b.

Pelagonema tenue Kreis 1928
Port Jackson N.S.W., Allgen 1951a.
Pontonema cobbi Mawson 1956
Macquarie I., Mawson 1958.
Pontonema donsi (Allgen 1932)
Lizard I. Q., Decraemer & Coomans 1978a.
Pontonema hackingi Mawson 1953
Port Hacking N.S.W., Mawson 1953.
Pontonema leidyi Mawson 1956
Macquarie I., Mawson 1958.
Pontonema serratodentatum Mawson 1956
Heard I., Macquarie I., Mawson 1958.
Prooncholaimus mawsonae Inglis 1971
Aquarium, Perth W.A., Inglis 1971.
Prooncholaimus megastoma (Eberth 1863)
Outer Harbour S.A., Mawson 1957.
Viscosia glabra (Bastian 1865)
Port Jackson, Disaster Bay N.S.W., Allgen 1951a.
Viscosia apud macramphida Chitwood 1951
Lizard I. Q., Decraemer & Coomans 1978a; Davies Reef Q., Alongi 1986.
Viscosia pellucida (Cobb 1898)
=*Oncholaimus pellucidus* Cobb 1898.
Port Jackson N.S.W., Cobb 1898.
Viscosia wieseri Mawson 1958
Macquarie I., Mawson 1958.

Echelidiidae
Calyptronema mawsoni Mawson 1958
Heard I., Macquarie I., Mawson 1958.
Enchelidium brevicaudatum Allgen 1947
Port Jackson N.S.W., Allgen 1951a.
Eurystomina californica (Allgen 1947)
=*Eurystomatina californicum* Allgen 1947
Port Jackson N.S.W., Allgen 1951a.
Eurystomina eurylaima (Ditlevsen, 1930)
=*Marionella euylaima* Ditlevsen 1930.
Radar Reef, Strickland Bay, Rottnest I., Woodmans Point, Cockburn Sound W.A., Inglis 1971.
Eurystomina fenestella Weiser 1953
Heard I., Macquarie I., Mawson 1958.
Eurystomina minutisculae Chitwood 1951
Lizard I. Q., Decraemer & Coomans 1978a.
Eurystomina ornata (Eberth 1863)
=*Eurystomatina ornata* (Eberth 1863) (given as *ornatum* by Allgen 1951a).
Port Jackson N.S.W., Allgen 1951a.
Ledovitia fallae Mawson 1958
Macquarie I., Mawson 1958.
Polygastrophora hexabulba (Filipjev 1918)
=*Bolbella pacifica* Ditlevsen 1930.
Port Jackson N.S.W., Allgen 1951a; Outer Harbour, Brighton, Port Willunga, Port Noarlunga S.A., Mawson 1957; Lizard I. Q., Decraemer & Coomans 1978a; Davies Reef Q., Alongi 1986.
Symplocostoma tenuicolle (Eberth 1863)
=*Enchelidium tenuicolle* Eberth 1863
=*Symplocostoma longicollis* Bastian 1865.
Tas., Allgen 1927; Port Jackson N.S.W., Allgen 1951a; Pennington Bay, Kangaroo I. S.A., Mawson 1953.
Symplocostomella johnstoni Mawson 1953
Point Gibbon N.S.W., Mawson 1953.

Tripyloididae
Bathylaimus australis Cobb 1894
Port Jackson N.S.W., Cobb 1894; Lizard I. Q., Decraemer & Coomans 1978a, b.
Tripyla tenuicauda Cobb 1893
Sydney N.S.W., Cobb 1893.

Tylenchida

Criconematidae
Criconemella avicenniae Nicholas & Stewart 1984
Hunter River Estuary N.S.W., Nicholas & Stewart 1984, Hodda & Nicholas 1986b.
Hemicriconemoides cocophilus (Loof 1949)
Lizard I. Q., Decraemer & Coomans 1978a.

Rhabditidae
Rhabditis marina Bastian 1865
Guilderton Beach, Herald Bay, Moore Bay, Dick Hartog I. W.A., Inglis 1961.

Tylenchidae
Eutylenchus africanus Sher, Corbett & Colbran 1966
Lizard I. Q., Decraemer & Coomans 1978a.

Dorylaimida

Nordiidae
Enchodelus coomansi Nicholas & Stewart 1984
Hunter and Clyde River Estuary N.S.W., Nicholas & Stewart 1984, Hodda & Nicholas 1986b.

Dorylaimidae
Prodorylaimus apud depressus Loof 1973
Lizard I Q., Decraemer & Coomans 1978a.

Leptonchidae
Proleptonchus saccatus (Clark 1962)
Lizard I. Q., Decraemer & Coomans 1978a.

The following generic records new to Australia were published by Johnston (1938) or Hodda & Nicholas (1985, 1986, 1987) but without species records:
Cyatholaimidae, *Pomponema;*

Desmodoridae, *Desmodorella, Metachromadoroides;*
Monoposthidae, *Nudora;*
Molgolaimidae, *Molgolaimus;*
Leptolaimidae, *Leptolaimus, Deontolaimus;*
Haliplectidae, *Haliplectus;*
Monhysteridae, *Diplolaimella, Diplolaimelloides;*
Epsilonematidae, *Epsilonematina;*
Draconematidae, *Drepanonema;*
Desmoscolecidae, *Greeffiella;*
Xyalidae, *Retrotheristus, Filipjeva Metadesmolaimus, Amphymonhystera;*
Comesomatidae, *Hooperia;*
Linhomoeidae, *Laimella;*
Axonolaimidae, *Parodontophora;*
Diplopeltidae, *Diplopeltis;*
Dorylaimidae, *Labronema;*
Oxystominidae, *Thallassolaimus;*
Tylenchidae, *Tylenchus.*

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DECRAEMER, W. 1977a. The genus *Desmolorenzenia* Freudenhammer, 1975 with a redescription of *D.crassicauda* (Timm 1970) (Nematoda–Desmoscolecida). Contribution no. VIII on the nematodes from the Great Barrier Reef, collected during the Belgian expedition in 1967. *Cahiers de Biologie Marine* **18**: 49–58.

DECRAEMER, W. 1977b. Scientific report on the Belgian expedition to the Great Barrier Reef in 1967. Nematodes IX. Four new species of *Quadricoma* Filipjev (Nematoda, Desmoscolecida). *Zoologica Scripta* **6**: 275–297.

DECRAEMER, W. 1978a. The genus *Quadricoma* Filipjev, 1922 with a redescription of *Q. cobbi* (Steiner 1916), *Q. crassicomoides* Timm 1970 and *Q. loricata* Filipjev 1922 (Nematoda, Desmoscolecida).

Contribution no. X on nematodes from the Great Barrier Reef, collected during the Belgian expedition in 1967). *Cahiers de Biologie Marin.* **19**: 63–89.

DECRAEMER, W. 1978b. Scientific report on the Belgian expedition to the Great Barrier Reef in 1967. Nematodes XIV: *Prototricoma dherdei* sp. nov. and *Desmolorenzenia cooleni* sp. nov. with a discussion of the genus *Prototricoma* Timm (Nematoda-Desmoscolecida). *Annls. Soc. R. Zool., Belg.*, **107**(3–4): 109–123.

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Index Of Available Species Group Names
(valid names in italics, invalid names in roman)

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wieseri *Sabatiera* 12
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youngei *Desmoscolex* 11

A REVISION OF THE AUSTRALIAN GENUS *DIEMENIA* SPINOLA (HEMIPTERA: PENTATOMIDAE: PENTATOMINAE)

I. AMHAD & S. KAMALUDDIN

AHMAD, I. & KAMALUDDIN, S. 1989. A revision of the Australian genus *Diemenia* Spinola (Hemiptera: Pentatomidae: Pentatominae) *Rec. S. Aust. Mus.* **23** (1): 21-31.

Diemenia immarginata (Dallas) and *D. rubromarginata* (Guérin-Méneville) are redescribed in addition to two new species *grossi* from Mt Buffalo and Mt Hotham, eastern Victoria and *minuta* from New England, Victoria, and from Green Hill Estate, South Australia, with special reference to their metathoracic scent auricles and male and female genitalia. *D. rubromarginata rubromarginata sensu stricto* and *D. rubromarginata deyrollei* Spinola, considered as two different subspeices of *D. rubromarginata* (Guérin-Méneville) by Gross (1976) are synonymised. A cladistic analysis of the taxa in the light of the above characters is also included.

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Species of *Diemenia* Spinola are Australian in distribution. Gross (1976) speculated that *D. immarginata* (Dallas) might reach New Zealand but we did not find any material from there. Another species, *D. rubromarginata* (Guérin-Méneville), is frequently found as adults and nymphs under eucalyptus bark in the wettest part of South Australia (Gross 1976).

Kirkaldy (1909) catalogued five species, *viz. affinis* (Dallas), *deyrollei* Spinola, *distinctus* (Montandon), *immarginatus* and *rubromarginatus*. *Gross (op. cit.)* examined the type material of the first four and a series of specimens of the fifth, and on this basis considered *affinis, deyrollei* and *distinctus* to be junior synonyms of *rubromarginata*. Gross (*op. cit.*) also described and illustrated the male genitalia (pygophore, paramere and partly inflated aedeagus) of *rubromarginata*, compared it with *D. deyrollei*, found no difference and therefore suggested that both represented the subspecies of *D. rubromarginatus*. The former (*D. rubromarginata rubromarginata sensu stricto* was considered to be the low altitude eastern and southern Australian subspecies).

In this paper *D. rubromarginata deyrollei* is considered to be a junior synonym of *D. rubromarginata rubromarginata*. In addition to *D. rubromarginata* and *D. immarginata*, two new species *D. grossi* and *D. minuta* are described with reference to metathoracic scent complex and male and female genitalia. A key to the four species is given and a cladistic analysis is presented. Dissection and inflation of the male genitalia utilised the technique of Ahmad (1986). For the dissection of the female genitalia, illustrations, and measurements, conventional procedures, especially those used by the present authors (1981), were generally followed. All the measurements are in millimetres.

Genus **Diemenia** Spinola

Diemenia Spinola, 1850, p. 35; Gross, 1976, p. 356.

Type-species: *D. rubromarginata* (Guérin-Méneville) (by monotypy)

Description

Coloration: Generally body dark brown or black with ochraceous patches.

Head: Distinctly broader than long; paraclypei much longer than clypeus but never enclosing the latter, produced into lobe-like structure just above the eyes; anteocular distance distinctly longer than remainder of head; antenniferous tubercles produced anteriad into spine-like process; antennae with basal segment longer than head apex, 2nd segment much longer than 3rd; labium reaching to hind coxae.

Thorax: Pronotum distinctly more than 2× broader than long, humeral angles prominent, lateral margins serrate; mesosternum sulcate; metathoracic scent gland ostiolar peritreme lobe-like, evaporating area rugulose; scutellum longer than broad, triangular; hemelytra with lateral margins sinuate.

Abdomen: Connexiva completely exposed at repose, sometimes tergal sclerites also exposed; 3rd and 4th abdominal venter with rugose vittae.

Male genitalia: Pygophore quadrangular, lateral lobes remarkably long; paramere Y-shaped; aedeagus with pair of many lobed dorsal membranous conjunctival appendage, penial lobes short, about equal to length of vesica.

Female genitalia: First gonocoxae triangular; 9th paratergites lobe-like and shorter than fused eighth paratergites; proctiger with posterior margin concave; spermathecal bulb with finger-like

processess, flanges distinct, pump region longer than bulb, proximal spermathecal duct much longer than distal spermathecal duct.

KEY TO THE SPECIES OF THE GENUS *DIEMENIA*

1 — Paraclypeal lobe in front of the eyes small; pygophore with bifurcated dorso-lateral lobes; inner lobe of blade of paramere with a single seta..... *rubromarginata* (Guérin-Méneville)

— Paraclypeal lobe in front of the eyes more prominent, pygophore with unilobed dorso-lateral lobes; inner lobe of blade of paramere without seta..... 2

2 — Entire lateral margins of pronotum distinctly serrate; tergites not exposed at repose; dorso-lateral lobes of pygophore laterally not produced; spermathecal bulb with two-finger-like processes..... *grossi* sp. nov.

— Only antero-lateral margins of pronotum serrate; tergites exposed at repose; dorso-lateral lobes of pygophore laterally produced; spermathecal bulb with three finger-like processes..... 3

3 — Anteocular distance slightly longer than remainder of head; 2nd labial segment shorter than 3rd; dorso-lateral lobes of pygophore beak-like..... ..... *immarginata* (Dallas)

— Anteocular distance about 1½× length of remainder of head; 2nd labial segment longer than 3rd; dorso-lateral lobes of pygophore lobe-like..... *minuta* sp. nov.

Diemenia grossi sp.nov.
(Figs. 1, 5, 9, 13, 17, 21, 25)

Description

Coloration: Body black, except lobe just above the eyes brown, thickly punctate; proximal ⅓ of 3rd and 4th antennal segments and anterolateral half of pronotum pale; a little anterobasal portion of corium, and each median connexival portion ochraceous; ocelli tinged reddish; eyes brownish black; membrane of hemelytra light brown. Total length of male = 10.2; female = 10.3.

Head: Anteocular distance (1.1) slightly more than 1½× remainder of head (0.7); paraclypeal lobe just above the eyes more prominent with rounded tips; antenniferous tubercles large with sharply pointed tips; antennae with 2nd segment distinctly more than 3× length of basal segment, length of segments I 0.8 (0.8–0.85), II 2.7 (2.7–2.95), III 1.6, IV 1.7 (1.5–1.7) labium with 4th segment longer than basal and slightly shorter than 3rd, length of segments, I 0.7 (0.7–0.8) II 1.1 (1.1–1.15), III 1.0 (1.0–1.1), IV 0.9; head width 2.65 (2.6–2.65); interocular distance 1.6; interocellar distance 0.6 (0.6–0.7).

Thorax: Pronotal width 5.0 (4.9–5.0) distinctly more than 2½× its length 1.9 (1.7–1.9), entire lateral margins distinctly serrate, anterior angle spinose and not reaching ½ length of eyes, humeral angle acute, (4.9–5.0); scutellum (length 3.5, 3.3–4.5; width 2.9, 2.9–3.0) with distinct apical lobe, metathoracic scent gland ostiolar peritreme (Fig. 5) lobe-like, apex acuminate, anteriorly directed; length base scutellum-apex clavus 2.7 (2.6–2.7); apex clavus-apex corium 2.3 (1.9–2.3); apex corium-apex abdomen including membrane 1.5 (1.5–2.0); apex scutellum-apex abdomen including membrane 3.0 (3.0–3.5).

Abdomen: Postero-lateral margin of 7th abdominal sternum sinuate; entire connexiva exposed at repose.

Male genitalia: Pygophore (Fig. 9) as long as broad, lateral lobe narrowed, elongate, inwardly directed, postero-dorsal margin medially convex; posteroventral margin medially shallowly concave; paramere (Fig. 13) with inner margin of inner lobe of blade convex, apex narrowed; aedeagus (Fig. 17) with dorsal membranous conjunctival appendage bilobed at base, each lobe formed by four-lobed structure, with pair of ventrolateral thecal appendages, vesica short, slightly shorter than penial plates.

Female genitalia (Fig. 21): First gonocoxae large, plate-like, somewhat triangular, medially close to each other; 2nd gonocoxae convex; 9th paratergites narrowed, lobe-like; posterior margins of fused 8th paratergites medially inpushed; spermatheca (Fig. 25) with margins of pump region distinctly sinuate, spermathecal bulb with two finger-like processes.

Material examined

Holotype male, New England National Park *via* Ebor, N.S.W. 22,23–1–1966, B. Cantrell, in Queensland Museum, Brisbane (Reg. No. T. 11, 107). Paratype: 1 female, Green Hill Estate, Foot hills, savannah form Ra. S.A. 24–8–1958, Under bark Mt Lofty, T.E. Woodward, in Department of Entomology, University of Queensland, Brisbane.

Comparative note

Diemenia grossi sp. nov. is most closely related to *immarginata* (Dallas) and *minuta* sp. nov. in having paraclypeal lobe just above the eyes prominent, and inner lobe of blade of paramere without seta but it can easily be separated from both by having entire lateral margin of pronotum distinctly denticulate, spermathecal bulb with two finger-like processes and by other characters as noted in the key and description.

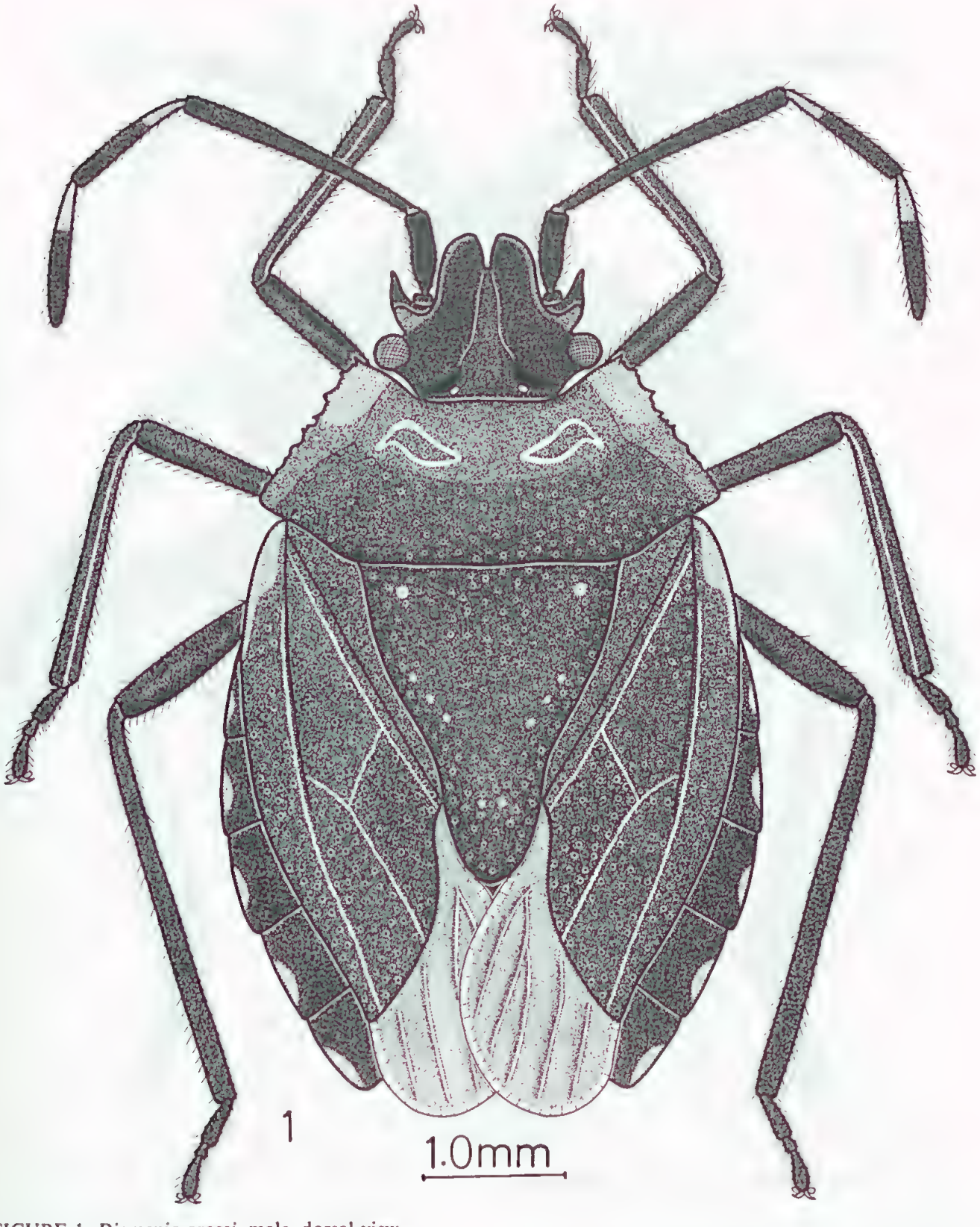


FIGURE 1. *Diemenia grossi,* male, dorsal view.

Diemenia immarginata (Dallas)
(Figs 2, 6, 10, 14, 18, 22, 26)

Platycoris immarginatus Dallas, 1851, p. 1.
Diemenia immarginata Gross, 1976, p. 363.

Description

Coloration and measurements: Body blackish brown, thickly punctate except narrow lateral margin of paraclypei, antennae with little basal portion of basal and 3rd segment, anterolateral margin of pronotum, scutellum with basal spot at

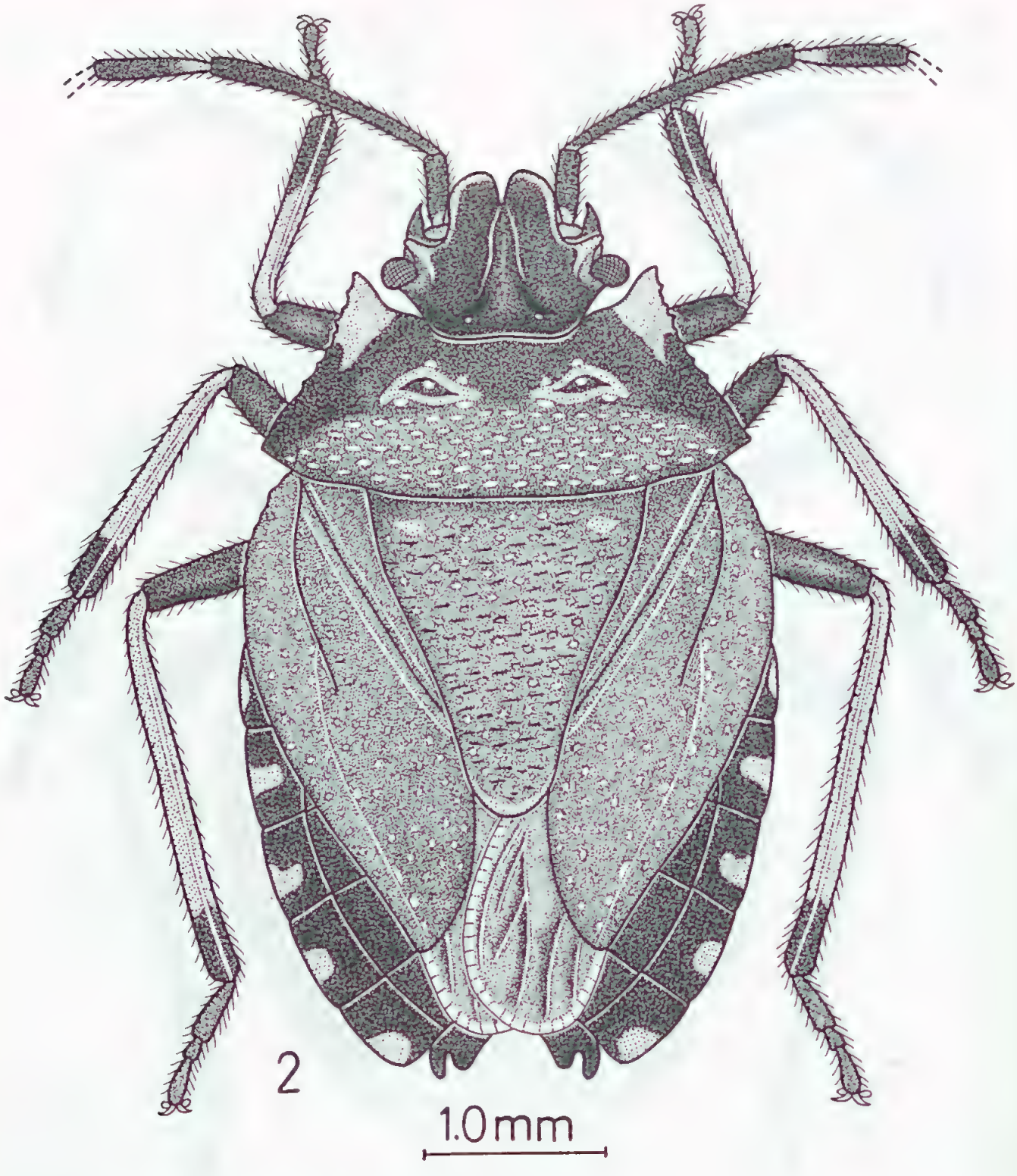


FIGURE 2. *Diemenia immarginata*, male, dorsal view.

each angle and apical little margin, about basal ⅔ portion of each tibiae and median little portion of each connexival joints light brown; ocelli brown; eyes brownish black; membrane of hemelytra brown. Total length of male = 9.0; female = 10.3.

Head: Anteocular distance 0.9 (0.8–0.9) slightly more than remainder of head 0.8 (0.65–0.8); paraclypeal lobe just above the eyes prominent with rounded tips; antenniferous tubercles large with sharply pointed tips; antennae with 2nd segment about 3× length of basal segment, length of segments, I 0.8 (0.7–0.8), II 2.3 (2.1–2.3), III 1.3 (1.2–1.3), IV mutilated; labium with 4th segment slightly longer than basal and distinctly shorter than 3rd, length of segments, I 0.7 (0.6–0.7), II 0.9, III 1.1 (1.0–1.1), IV 0.8 (0.7–0.8); head width 1.95

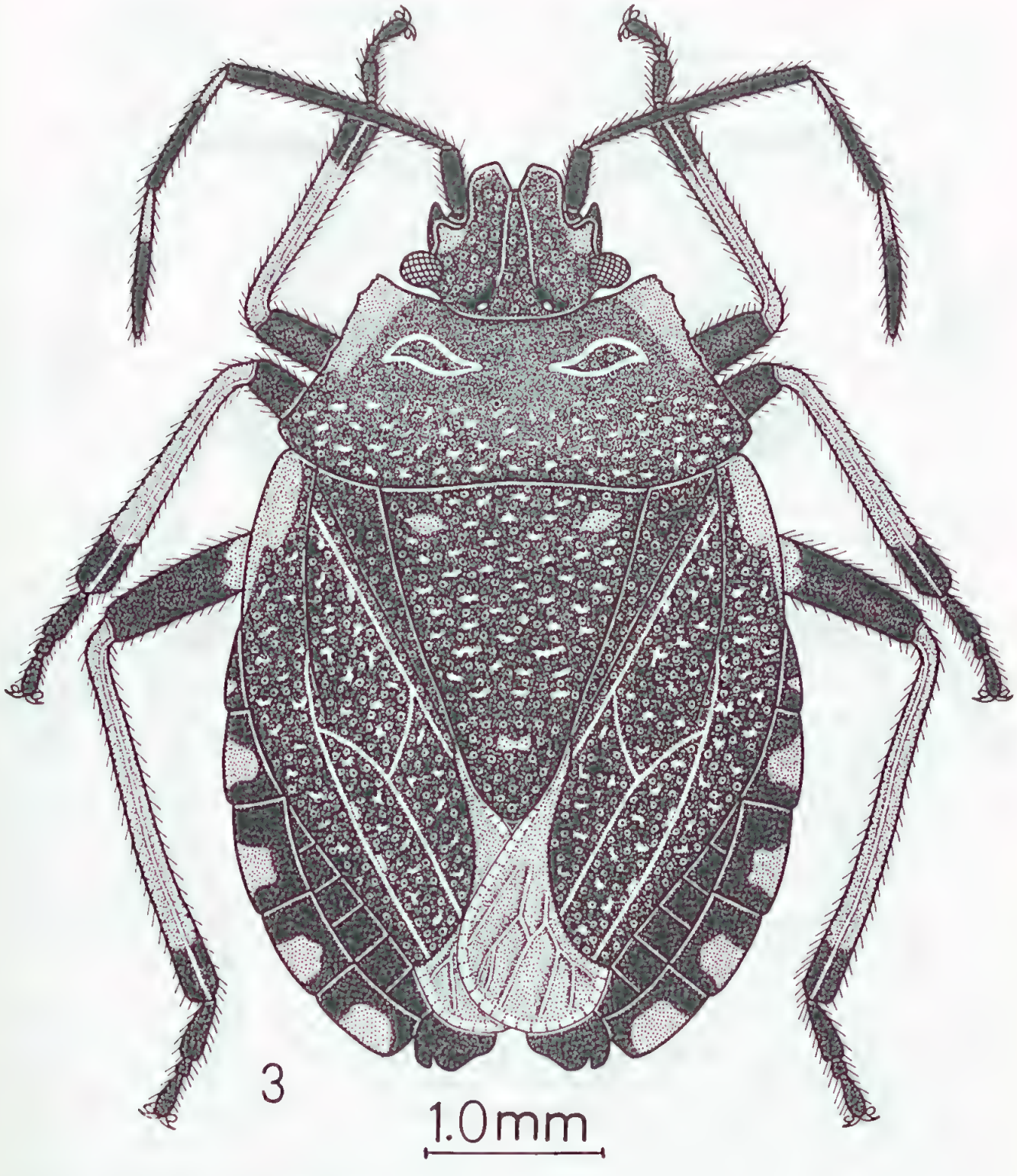


FIGURE 3. *Diemenia minuta*, male dorsal view.

(1.95–2.15); interocular distance 1.6 (1.4–1.6); interocellar distance 0.65.

Thorax: Pronotal width 4.6 (4.4–4.6) distinctly more than 2½× its length 2.7 (2.65–2.7), antero-lateral margin of pronotum dentate, anterior angle produced and passing more than ½ length of eye, humeral angles acute; scutellum (length 3.2, 2.85–3.2; width 2.7, 2.65–2.7) with less distinct apical lobe; metathoracic scent gland ostiolar peritreme (Fig. 6) lobe-like apex round and antero-laterally directed; length base scutellum–apex clavus 2.4 (2.2–2.4); apex clavus–apex corium 2.1 (1.8–2.1); apex corium–apex abdomen including membrane 1.1 (1.1–1.8); apex scutellum–apex abdomen including membrane 2.5 (2.5–2.8).

Abdomen: Postero-lateral margin of 7th abdominal sternum sinuate, entire connexiva and last three tergal segments exposed at repose.

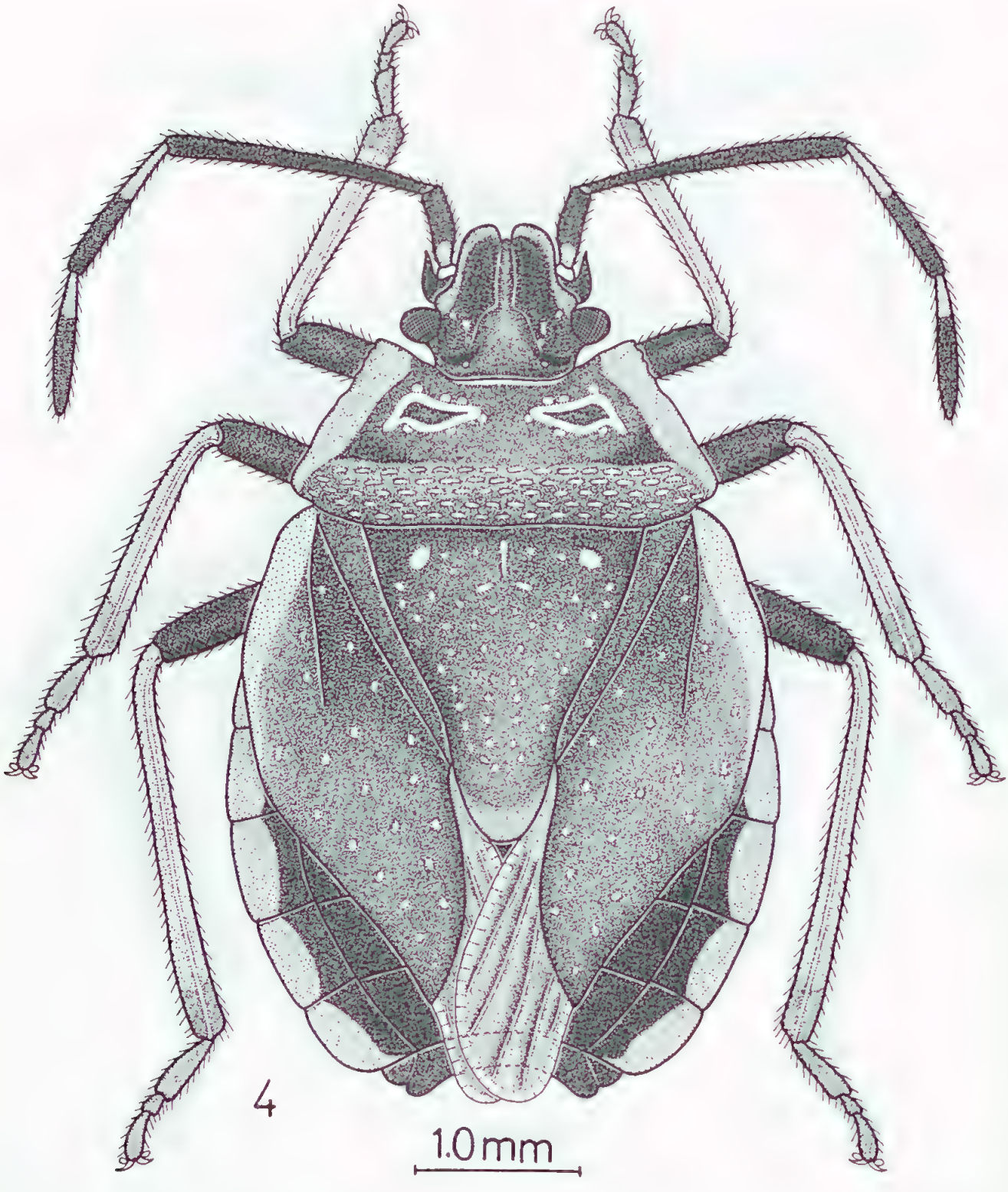
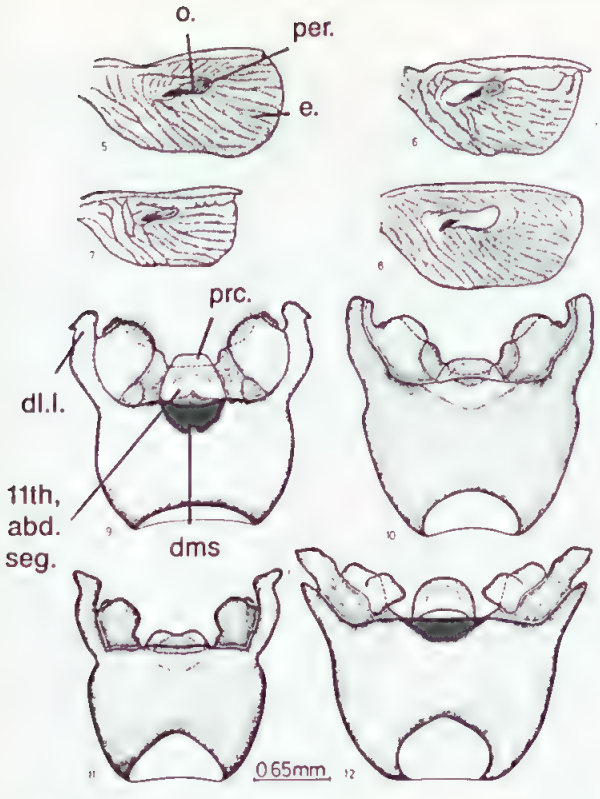


FIGURE 4. *Diemenia rubromarginata*, male, dorsal view.

Male genitalia: Pygophore (Fig. 10) slightly broader than long, lateral lobe narrowed, beak-shaped, outwardly directed, postero-dorsal margin sinuate; paramere (Fig. 14) with inner margin of the inner lobe of blade convex, apex narrowed; aedeagus (Fig. 18) with dorsal membranous conjunctival appendage bilobed at base, each lobe formed by four-lobed structure, with pair of ventro-lateral thecal appendages, vesica short, slightly shorter than penial plates.

Female genitalia (Fig. 22): First gonocoxae large, plate-like, somewhat triangular, medially close to each other; 2nd gonocoxae concave; 9th paratergites broad, lobe-like; posterior margins of fused 8th paratergites medially slightly concave; spermatheca (Fig. 26) with margins of pump region slightly



FIGURES 5–12. *Diemenia* species: 5–8, metathoracic scent gland ostioles, ventral view; 5, *grossi*, 6, *immarginata*, 7, *minuta*, 8, *rubromarginata*; 9–12, pygophore, dorsal view, 9, *grossi*, 10, *immarginata*, 11, *minuta*, 12, *rubromarginata*. 11th, abd. seg. (Eleventh abdominal segment); dl.l. (dorso-lateral lobe); dms (dorso-median surface); e. (evaporatoria); o. (ostiole); per. (peritreme); prc. (proctiger).

sinuate, spermathecal bulb with three finger-like processes.

Material examined

1 male, Burnie Tas. Lea. det. G.F. Gross 1987, 1 female, Mt Kosciusko. B. Ingleby. det. G.F. Gross 1987, in South Australian Museum, Adelaide.

Comparative note

Diamenia immarginata (Dallas) is most closely related to *minuta* sp. nov. in having only antero-lateral margins of pronotum denticulate, tergites exposed at repose and spermathecal bulb with three finger-like processes but it can easily be separated from the same by having anteocular distance only slightly longer than remainder of head and lateral lobes of pygophore pointed into a beak-like structure and by other characters as noted in the key and description.

Diemenia minuta sp. nov.
(Figs. 3, 7, 11, 15, 19, 23, 27)

Description

Coloration and measurements: Body ochraceous black, thickly punctate; except narrow lateral margins of paraclypei, antennae with 1st and 2nd, of proximal ⅓ of 3rd and 4th segments, anterolateral margins of pronotum, a small spot at each basal angle and on apical lobe of scutellum, antero-lateral patch on corium, proximal ½ of femur, more than proximal ⅔ of portion of each tibia, median little portion of each connexival suture ochraceous; ocelli tinged red; eyes dark; membrane of hemelytra brown. Total length male = 8.30; female = 9.70.

Head: Anteocular distance 0.9 (0.9–0.95) about 1½× length remainder of head 0.6 (0.6–0.65); paraclypeal lobe just above eyes prominently developed with rounded tips; antenniferous tubercles moderate with blunt tips; antennae with 2nd segment equal or slightly longer than 3× length of 1st segment, length of segments I 0.7, II 2.3 (2.1–2.3), III 1.4 (1.2–1.4), IV 1.5; labium with 4th segment equal to 1st and distinctly shorter than 3rd, length of segments, I 0.6 (0.6–0.75), II 1.05 (1.0–1.05), III 1.0, IV 0.6 (0.6–0.75); width head 2.2 (2.2–2.3); interocular distance (1.4, 1.4–1.5); interocellar distance 0.6.

Thorax: Width of pronotum 4.1 (4.1–4.35), about 2½× its length 1.6 (1.6–1.8); antero-lateral margin serrate, anterior angle blunt and not reaching ½ length of eyes, humeral angles acute; scutellum (length 2.8, 2.8–3.3; width 2.5, 2.5–2.9) with less distinct apical lobe; metathoracic scent gland ostiolar peritreme (Fig. 7) lobe-like, apex narrowed, anterolaterally directed; length base scutellum-apex clavus 2.2 (2.2–2.6); apex clavus-apex corium 1.9 (1.9–2.1); apex corium-apex abdomen including membrane 0.8 (0.8–1.6); apex scutellum-apex abdomen including membrane 2.4 (2.4–3.0).

Abdomen: Postero-lateral margin of 7th abdominal sternum sinuate; entire connexiva and last three tergal segments exposed at repose.

Male genitalia: Pygophore (Fig. 11) as long as broad, lateral lobe narrowed, elongate, outwardly directed, postero-dorsal margin medially sinuate, postero-ventral margin medially shallowly concave; paramere (Fig. 15) with inner margin of inner lobe of blade convex, apex narrowed and acuminate; aedeagus (Fig. 19) with dorsal membranous conjunctival appendage bilobed at base, each lobe formed by trilobed structure, with pair of ventrolateral thecal appendages, vesica short, slightly shorter than penial plates.

Female genitalia (Fig. 23): First gonocoxae large, plate-like, somewhat triangular, medially close to each other; 2nd gonocoxae straight; 9th paratergites broad, lobe-like; posterior margins of fused 8th paratergites medially slightly concave; spermatheca (Fig. 27) with margins of pump region medially notched, spermathecal bulb with three finger-like processes.

Material examined

Holotype male, Mt Buffalo National Park, east Victoria, 17–1–1966, B. Cantrell, in Queensland Museum, Brisbane (Reg. No. T.11, 106). Paratype; 1 female, Mt Hotham, east Victoria 16–1–1966, T. Weir, Department of Entomology, University of Queensland, Brisbane.

Comparative note

Diamenia minuta sp. nov. is most closely related to *D. immarginata* (Dallas) as noted under the comparative note of that species, but it can easily be separated from the same by having 2nd labial segment longer than 3rd as compared to 2nd labial segment shorter than 3rd in *D. immarginata* and by other characters as noted in the key and description.

Diamenia rubromarginata (Guérin-Méneville)

(Figs. 4, 8, 12, 16, 20, 24, 28)

Platycoris rubromarginatus Guérin-Méneville, 1830, p. 169.
Diemenia rubromarginata Gross, 1976, p. 366.
Platycoris distinctus Montandon, 1903, p. 286.
Platycoris affinis Dallas, 1851, p. 154.
Diemenia deyrollei Spinola, 1850, p. 91.
Diemenia rubromarginata deyrollei Spinola (*sic* Signoret) 1850, Gross, 1976, p. 366.

Description

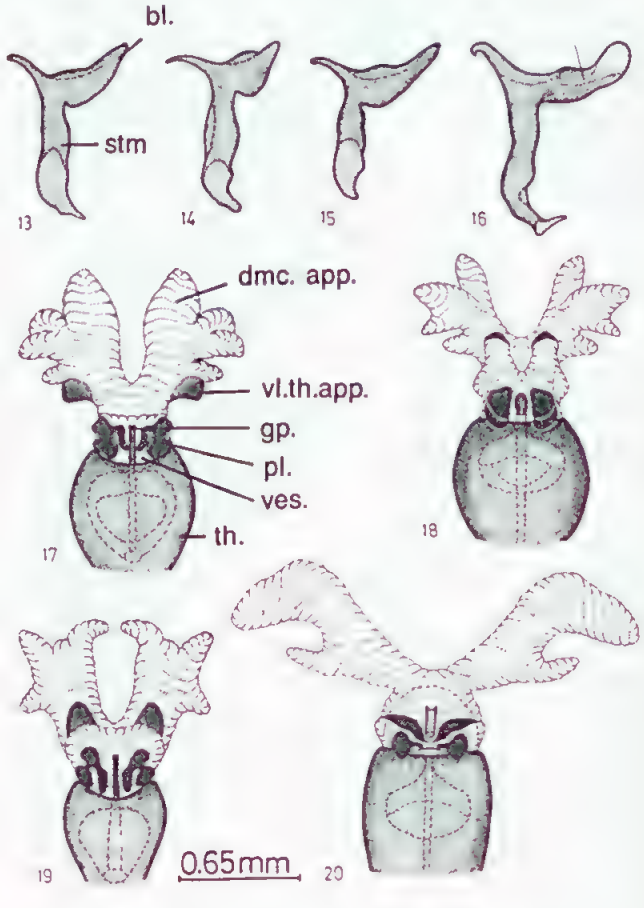
Coloration and measurements: Body dark brown, thickly punctate, except narrow lateral margin of paraclypei, antennae with small basal arch of 1st proximal ⅓ of 4th and 5th, entire lateral margins of pronotum, one spot at each basal angle of scutellum, proximal half of lateral margin of corium, tibia excluding small distal part, lateral connexival sutures pale; little distal portion of tibia and all tarsi light brown; ocelli tinged reddish; eyes dark brown; membrane of hemelytra brown. Total length male 9.9 (9.15–10.0); female 9.6 (9.4–9.6).

Head: Anteocular distance 0.9 (0.85–0.9) slightly longer than remainder of head 0.8 (0.7–0.8); paraclypeal lobe just above the eyes poorly developed with rounded tips; antenniferous tubercles large with sharply pointed tips; antennae with 2nd segment more than 3× length of basal segment; length of segments, I 0.9, II 2.9 (2.9–3.0), III 1.4 (1.4–1.6), IV 1.5; labium with 4th segment distinctly shorter than basal and slightly shorter than 3rd, length of segments, I 1.1, II 1.2, III 1.0, IV 0.9; head width 2.5 (2.35–2.5); interocular distance 1.5 (1.35–1.55), interocellar distance 0.7 (0.7–0.75).

Thorax: Width of pronotum 4.6 (4.3–4.8) distinctly more than 2½× its length 1.6 (1.5–2.9); antero-lateral margin serrate, anterior angles acute and much shorter than ½ length of the eyes, humeral angles sub-rounded, scutellum (length 3.1, 2.9–3.3; width 3.0, 2.7–3.0) with distinct apical lobe; metathoracic scent gland ostiolar peritreme (Fig. 8) elongate, spatulate, apex narrowed, anteriorly directed; length base scutellum–apex clavus 2.4 (2.0–2.5); apex clavus–apex corium 2.5 (2.1–2.6); apex corium–apex abdomen including membrane 1.6 (1.4–1.9); apex scutellum–apex abdomen including membrane 3.2 (3.0–3.2).

Abdomen: Postero-lateral margin of 7th abdominal sternum somewhat straight; entire connexiva and last three abdominal terga exposed at repose.

Male genitalia: Pygophore (Fig. 12) much broader than long, lateral lobes narrowed at apex and shorter, postero-dorsal margin medially slightly convex, posteroventral margin deeply concave; paramere (Fig. 16) with inner margin of inner lobe of blade sinuate, apex broad, outer lobe curved



FIGURES 13–20. Parameres, inner view, 13, *grossi*, 14, *immarginata*, 15, *minuta*, 16, *rubromarginata*; 17–20, aedeagus, dorsal view, 17, *grossi*, 18, *immarginata*, 19, *minuta*, 20, *rubromarginata*. bl. (blade); dmc. app. (dorsal membranous conjunctival appendage); gp. (gonopore); pl. (penial lobe); stm (stem); th. (theca); ves. (vesica); vl. th. app. (ventro-lateral thecal appendage).

inward, beak-like; aedeagus (Fig. 20) with dorsal membranous conjunctival appendage bilobed at base, each lobe formed by bilobed structure, with pair of ventral thecal appendages, vesica short, about equal to length of penial plates.

Female genitalia (Fig. 24): First gonocoxae large, plate-like, somewhat triangular, medially wide apart; 2nd gonocoxae concave; 9th paratergites narrowed, lobe-like; posterior margins of fused 8th paratergites medially inpushed; spermatheca (Fig. 28) with margins of pump region slightly sinuate, spermathecal bulb with three finger-like processes.

Material examined

1 male, 1 female South Australia, Horsnells Gully, Lower Hermitage, 17.10.1891, 14–18–5–1966, J.W. Mellor, J. Herridge, det. G.F. Gross 1987; 1 male, 1 female Hobart, Tasmania — J.J. Walker collection, in British Museum (Natural History), London; 1 female, Jasmann Loan No. HE 702/84, in Zoological Museum Helsinki, Finland.

Comparative note

Diemenia rubromarginata (Guérin-Méneville) resembles most *D. immarginata* (Dallas) in having antenniferous tubercules remarkably developed and spine-like and paraclypei much longer than clypeus, but it can easily be separated from all the *Diemenia* species by having paraclypeal lobe just above the eyes less prominent and inner lobe of the blade of paramere with a single seta, and by other characters as noted in the key and description.

Cladistic Analysis of the Included Taxa

Ahmad & Kamaluddin (1989) have presented a cladogram of some genera of the *Diemenia* group of Gross (1976) including *Diemenia* and *Niarius*. Here a cladistic analysis of *Diemenia* species is given based upon 14 characters. Polarity was determined on the basis of out-group comparison with the members of the superfamily Pentatomoidea and Trichophora. No homoplasy had to be invoked.

Character and Character States

1. *Lunate patch above ocelli* (a): Ahmad & Kamaluddin (1989) examined representatives of a number of genera of the *Diemenia* group of Gross (1976) and considered it apomorphic. It is a unique condition in the entire Family Pentatomidae and is only found in *Diemenia* and *Niarius* species and therefore is considered here to be their synapomorphy.

2. *Lateral lobes of paraclypei just above the eyes* (b): Ahmad & Kamaluddin (1989) found this condition in those of several genera of the *Diemenia* group and have considered it apomorphic. Following their reasoning in *grossi, immarginata* and *minuta* the condition of more prominent lateral lobes is considered here to be a further derived state (b_2).

3. *Anterior lobes of pronotum produced and directed anteriad* (c): It is a rare condition and is noticed in some tetrodines of Phyllocephalinae and Ahmad & Kamaluddin (1988b) have considered it to be apomorphic. Following their reasoning this character state in *immarginata* and *minuta* also reflects their synapomorphy. In *immarginata* the apex of anterior lobes appears narrower and more prominent and probably reflects a more derived state (c_2 in Fig. 29).

4. *Lateral margins of pronotum crenulate* (d): In halyines and some asopines a portion of the lateral margin of pronotum is crenulate like those of lestonocorines which state was considered to be apomorphic by Schaefer & Ahmad (1987). In *Diemenia* and *Niarius* species also this character state looks apomorphic (d). On the other hand the entire lateral margin showing marked crenulations in *grossi* looks to be a more derived state (d_2 in Fig. 29).

5. *Patch on the apical lobe of scutellum* (e): In several groups of Pentatominae including those of *Diemenia* species there is usually a spot on each basal angle of the scutellum but the spot on the apical lobe of the scutellum is very rare and it is certainly apomorphic in *minuta*.

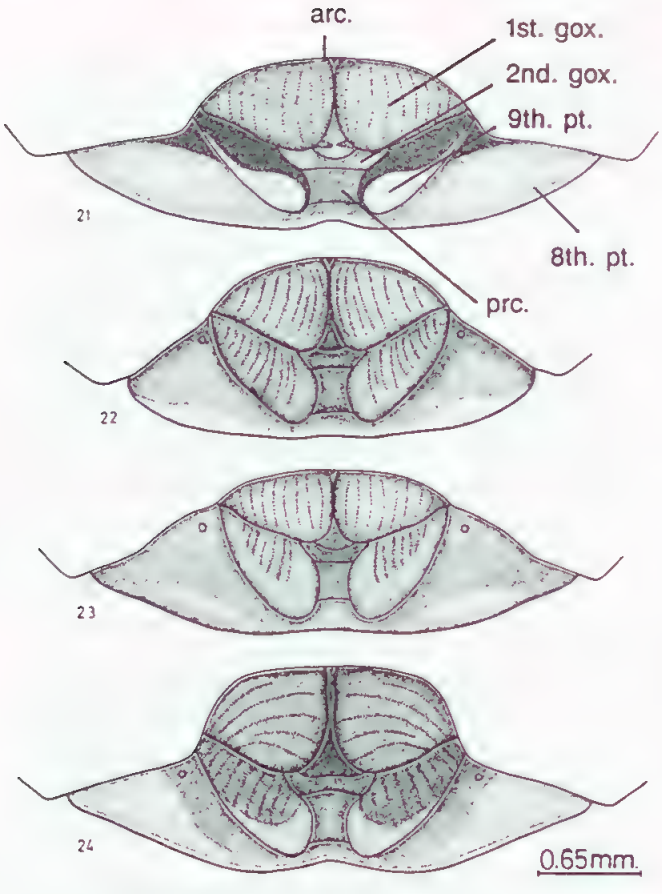
6. *Tibiae sulcate* (f): Sulcated tibiae are encountered in some groups of Trichophora as in coreines and was considered derived by Ahmad (1979). The sulcated tibiae in *Diemenia* species are also considered here to be their autapomorphy.

7. *Tibiae flattened* (g): This character is also remarkably rare in Trichophora as is the case in some coreine Trichophora and it also appears to be an autapomorphy of *Niarius* species.

8. *Sides of abdomen exposed* (h): In most of the Pentatominae only a small portion of connexiva is exposed but in *Diemenia* species not only the entire connexiva are exposed but the sides of the abdomen are also in some cases exposed. This is certainly autapomorphy of the group.

9. *Dorsolateral lobes of pygophore remarkably prominent* (i): This appears a rare character in Pentatominae. Ahmad & Kamaluddin (1989) also considered it apomorphic in certain genera of the *Diemenia* group. Laterally directed tips of these lobes appear more derived in *immarginata* and *minuta* (i_2). In *minuta* however the laterally directed portion is remarkably prominent and this state appears to be further derived (i_3 in Fig. 29).

10. *Outer margin of paramere with an arch-shaped tooth-like structure* (j): This is a rare condition in Pentatominae and Ahmad & Kamaluddin (1989)



FIGURES 21–24. Female terminalia, ventral view, 21, *grossi*, 22, *immarginata*, 23, *minuta*, 24, *rubromarginata*. 1st gox. (first gonocoxae); 2nd. gox. (second gonocoxae); 8th. pt. (eighth paratergite); 9th. pt. (ninth paratergite); arc. (arcus); prc. (proctiger).

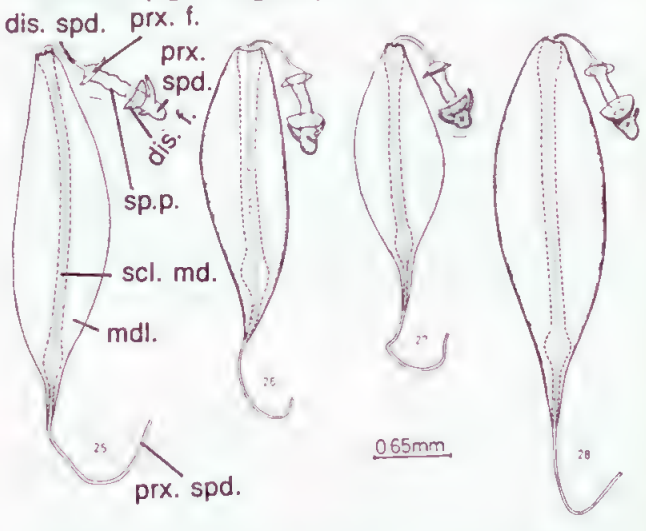
also considered it synapomorphy of some genera of the *Diemenia* group. In *immarginata* this lobe appears slender, more elongate and acute at the apex and reflects a more derived state (j_2 in Fig. 29). In *rubromarginata* however the apex of the outer lobe is recurved which looks to be a further derived condition (j_3 in Fig. 29).

11. *Base of inner lobe of paramere with a bristle* (k): This is an extremely rare condition in Pentatominae and is only found in *D. rubromarginata* which is considered here to be its autapomorphy.

12. *Dorsal membranous conjunctival apendage multilobed* (l): In most of the Pentatominae the dorsal membranous conjunctival appendage is bilobed (Ahmad 1979). In *rubromarginata* each lobe is divided into two lobules which is certainly a derived state in this species. In *grossi, immarginata* and *minuta* each lobe is divided into several lobules which appears to be a further derived condition (l_2 in Fig. 29).

13. *Ovipositor partly concealed by 1st gonocoxae* (m): In Pyrrhocoroidea, Ahmad & Schaefer (in manuscript) have considered partly concealed external genitalia to be an apomorphic state because it is very rare in Trichophora. Following their reasoning in *Niarius* species the ovipositor partly concealed by the first gonocoxae is considered here to be an autapomorphy of the group.

14. *Spermathecal bulb with finger-like processes* (n): In some groups of Pentatominae the spermathecal bulb possesses finger-like processes which were considered to be apomorphic by Ahmad & Kamaluddin (1989). Following their argument, possession of three processes in most of the *Diemenia* species (one or two processes in *Niarius* species) is considered here to be a more derived condition (n_2 in Fig. 29).



FIGURES 25–28. Spermatheca, 25, *grossi*, 26, *immarginata*, 27, *minuta*, 28, *rubromarginata*. dis. f. (distal flange); dis. spd. (distal spermathecal duct); mdl. (median dilation); pr. spb. (process of spermathecal bulb); prx. f. (proximal flange); prx. spd. (proximal spermathecal duct); scl. md. (sclerotized median duct); spb. (spermathecal bulb); sp.p. (spermathecal pump).

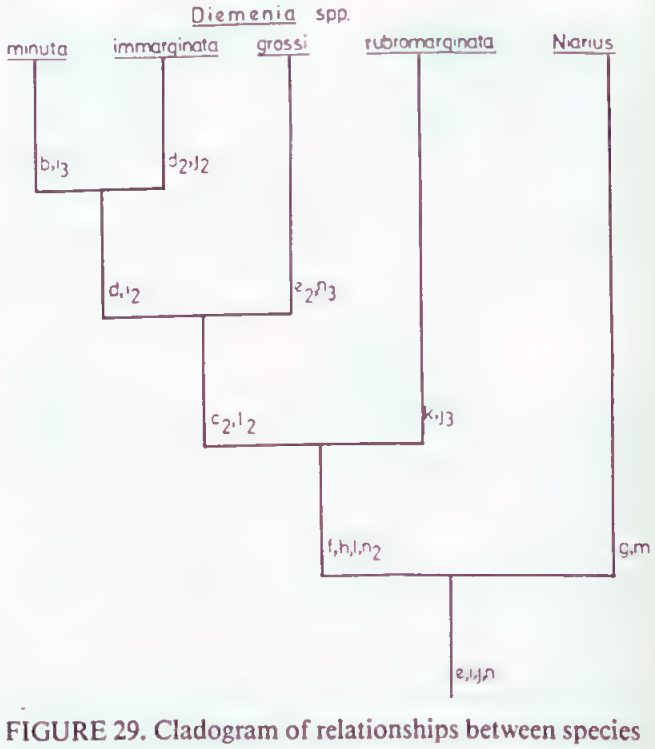


FIGURE 29. Cladogram of relationships between species of *Diemenia*.

Discussion of Cladogram

Ahmad & Kamaluddin (1989) also considered *Niarius* and *Diemenia* species to be sister groups. *D. rubromarginata* appears isolated among the *Diemenia* species in having sister group relationship with *grossi, immarginata* and *minuta.* On the other hand *minuta* and *marginata* appear most closely related, and *grossi* to be their sister group. The anteriorly directed anterior lobes of the pronotum and laterally directed dorsolateral lobes of the pygophore suggest that the two species are most closely related, and the complex multilobed dorsal membranous conjunctival appendages and more prominent lateral lobes of the paraclypei above the eyes, confirm the sister group relationship of *grossi* with *immarginata* and *minuta.*

ACKNOWLEDGMENT

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A NEW GENUS AND SPECIES OF THE *DIEMENIA* GROUP (HEMIPTERA: PENTATOMIDAE: PENTATOMINAE) FROM AUSTRALIA, WITH CLADISTIC ANALYSIS OF SOME RELATED GENERA

I. AHMAD & S. KAMALUDDIN

AHMAD, I. & KAMALUDDIN, S. 1989. A new genus and species of the *Diemenia* group (Hemiptera: Pentatomidae: Pentatominae) from Australia with cladistic analysis of some related genera. *Rec. S. Aust. Mus.* 23 (1): 33–38.

A new genus and species from 'Mt Emlyn', Australia, are described with special reference to their metathoracic scent auricles and male and female genitalia. The new taxa are compared with their closest allies of *Diemenia* Spinola, and *Niarius* Stal in the *Diemenia* group of Gross (1976) and a cladistic analysis of the related genera of the above group is presented.

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Gross (1976) described his *Diemenia* group with the characteristic feature of strigose vittae forming a curved line laterally on the abdomen on segments II, III, and IV, or II and III, or III and IV to accommodate aberrant groups like his *Boocoris*, *Alphenor* Stal and *Caridophthalmus* Assman along with *Diemenia* Spinola, *Niarius* Stal and *Aplerotus* Dallas and four others with five-segmented antennae. Ahmed *et al.* (1982) suspected that the strigose vittae which link the members of Diemeniini Kirkaldy or the *Diemenia* group are shared by the members of remarkably diverse groups. Earlier Bergroth (1905) also recognised two different patterns of strigose vittae, *viz.* arranged in a single straight row in the members of *Commius* Stal and *Oncocoris* Mayr and in two or three irregular rows in *Diemenia* and *Niarius*. Gross (1976) also considered strigose vittae of *Caridophthalmus* species very different from those of *Boocoris*.

During a revision of *Niarius* and *Diemenia* (present authors in manuscript), we examined a male and a female specimen from 'Mt Emlyn', Australia by the courtesy of Dr A. Neboiss, Museum of Victoria. These looked intermediate between *Diemenia* and *Niarius* in the characters as noted under the following comparative note and cladistic analysis. The resemblance to the above two genera was so striking that the male was identified as *Niarius* or an allied new genus and the female as *Diemenia* (sp. nov.) by Dr G.F. Gross of the South Australian Museum, Adelaide. These are described below as *Grossimenia* with its type species *tuberculata* with special reference to the metathoracic scent auricles and male and female genitalia. It is compared with its closest allies *Diemenia*, *Niarius* and *Aplerotus*, and in the light of these characters a cladistic analysis of related genera of the *Diemenia* group is also presented.

For the examination of the male genitalia and especially for the inflation of the aedeagus, the techniques of Ahmad (1986) were used. For the examination of the female genitalia and for descriptions, illustrations and for measurements the conventional procedures especially those used by Ahmad *et al.* (1982) were generally followed. All the measurements are in millimetres.

Genus ***Grossimenia*** gen. nov.

Type-species: *Grossimenia tuberculata* sp. nov.

Description

Coloration and general shape: Generally dark brown with ochraceous patches; elongate, covered with tubercles.

Head: Slightly longer than broad; eyes nonstylate, paraclypei shorter than clypeus, forming a lobe in front of the eyes; anteocular distance much longer than remainder of head; antenniferous tubercles visible from above, laterally slightly projected and pointed but not spinously produced; antennae four-segmented, with 1st segment shorter than head, 2nd segment longest and much longer than 3rd; labium very long, reaching to 7th abdominal venter.

Thorax: Pronotum slightly more than 2 × broadthan long, humeral angles sub-rounded, lateral margins serrate; scutellum elongate, much longer than broad; antero-lateral margins of corium crenulate, meso-sternum sulcate; metathoracic scent auricles spatulate, evaporating area distinctly rugulose; hind femora armed with several spines.

Abdomen: Connexiva exposed at repose; 3rd and 4th abdominal venter with strigose vittae.

Male genitalia: Pygophore quadrangular, lateral lobes large and narrowed at apex; paramere T-shaped; aedeagus with bilobed dorsal membranous conjunctival appendage, vesica short.

Female genitalia: First gonocoxae somewhat triangular; 9th paratergites triangular with apices narrowed, much shorter than fused posterior margin of 8th paratergites.

Etymology

The new genus is named *Grossimenia* in honour of Dr G.F. Gross, South Australian Museum, who originally recognised the taxon to be near *Diemenia* and *Niarius.*

Comparative note

Grossimenia is closely allied to *Niarius* in having only the connexiva exposed at repose and the outer lobe of the paramere small, and to *Diemenia* in having the lateral margins of the pronotum always serrate. It can be separated from both in having the body elongate, paraclypei shorter than the clypeus and labium very long, reaching to 7th abdominal venter.

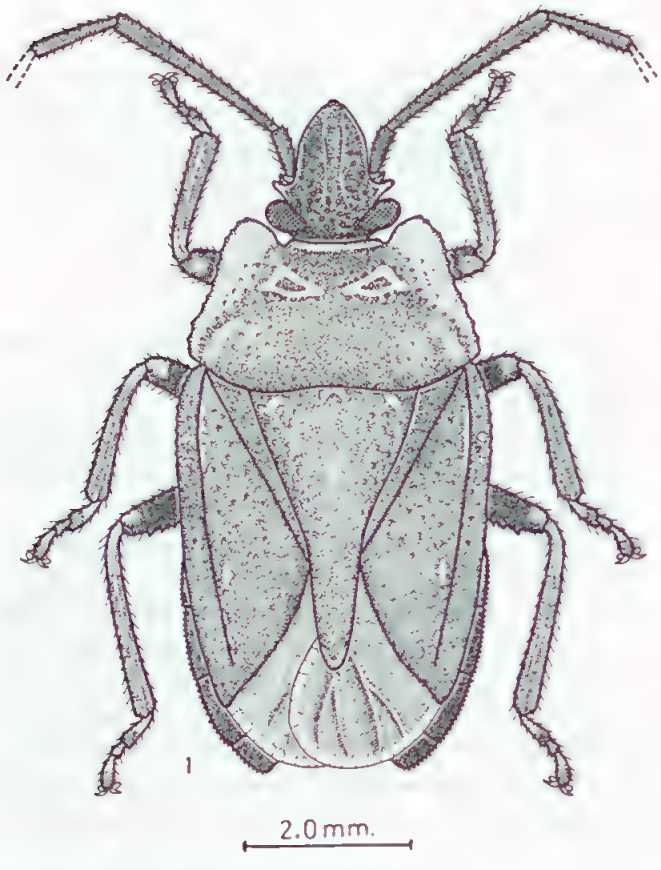


FIGURE 1. *Grossimenia tuberculata.*

Grossimenia tuberculata sp. nov.

(Fig. 1–6)

Description

Coloration and measurements: Dark brown except narrow lateral margins of paraclypei and lateral margins of pronotum; three basal spots on scutellum; apex of femora, basal portion of tibiae and tarsi, ochraceous; eyes blackish brown; ocelli brownish; membrane of hemelytra light brown. Total length male = 7.35; female = 8.45.

Head: Paraclypei with apex acuminate, paraclypeal lobe just above the eyes prominent, lobe-like; anteocular distance 1.15 (1.15–1.25) about or more than 2½× length of remainder of head 0.4 (0.4–0.5); width of head 1.5 (1.5–1.76); interocular distance 1.0 (1.0–1.05), interocellar distance 0.5 (0.5–0.55); antennae with basal segment much shorter than head length and ⅓ of 2nd, length of segments, I 0.55 (0.55–0.6), II 1.9 (1.8–1.9), III 1.1 (1.05–1.1), IV mutilated; labium with 2nd segment longest, 4th shortest, length of segments; I 1.4; II 1.6 (1.6–1.9), III 1.5 (1.5–1.6), IV 1.1 (1.0–1.1).

Thorax: Pronotum with anterior and humeral angles broad, length 1.5 (1.5–1.6); width 3.1 (3.1–3.4); scutellum laterally distinctly bilobed, apex acuminate, length 3.1 (3.1–3.7); width 1.9 (1.9–2.0); metathoracic scent gland ostiolar peritreme (Fig. 2) lobe-like, anterior margin sinuate, apex narrowed, acuminate, directed laterad; with spines; membrane of hemelytra shorter than abdomen; distance base scutellum-apex clavus 1.9 (1.9–2.1); apex clavus-apex corium 1.3 (1.3–1.7); apex corium-apex abdomen including membrane 0.9 (0.9–1.1); apex scutellum-apex-abdomen including membrane 1.2 (1.2–1.4).

Abdomen: Connexiva slightly exposed at repose; anterolateral margin of 7th abdominal sternum sub-rounded.

Male genitalia: Pygophore (Fig.3) broader than long, dorso-median surface medially slightly produced and straight, ventro-posterior margin medially deeply inpushed, lateral lobes elongate with apex narrowed, lateral margins sinuate; paramere (Fig. 4) with inner arm broad, apex narrowed, outer arm curved, spine-like, outer margin sinuate; aedeagus (Fig. 5) with tips of bilobed dorsal membranous conjunctival appendage sclerotized, penial lobes large, plate-like, vesica not reaching fused margin of bilobed dorsal membranous conjunctival appendage.

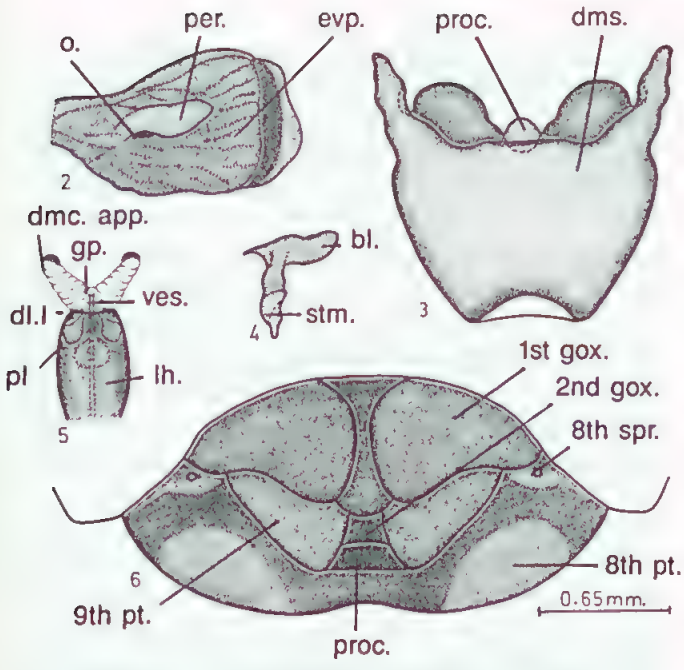
Female genitalia (Fig. 6): First gonocoxae large, plate-like, posterior margin distinctly sinuate; 9th paratergites elongate; posterior margin of fused arcus and triangulin convex; 2nd gonocoxae posteriorly concave; posterior margin of proctiger straight, fused posterior margin of 8th paratergites medially inpushed.

Material examined:

Holotype male, *Australia* 'Mt Emlyn' — Q, 12.5. 1937 in National Museum of Victoria. Paratype female, same data, in National Museum of Victoria.

Comparative note and etymology:

At present it is the only known species of *Grossimenia* gen. nov. but its tuberculate body, from which its name is derived, should isolate it in its genus.



FIGURES 2–6. *Grossimenia tuberculata*: 2, metathoracic scent gland ostioles, ventral view; 3, pygophore, dorsal view; 4, paramere, inner view; 5, aedeagus, dorsal view; 6, female genitalia, ventral view. 1st gox. (first gonocoxae); 2nd gox. (second gonocoxae); 8th pt. (eighth paratergite); 8th spr. (eighth spiracle); 9th. pt. (ninth paratergite); arc. (arcus), bl. (blade); dl. l (dorsal-lateral lobe); dmc. app. (dorsal membranous conjunctival appendage); dms. (dorso-median surface), evp. (evaporatoria); gp. (gonopore); o. (ostile); per. (preitreme); pl. (penial lobe); proc. (proctiger); stm. (stem); th. (theca); ves. (vesica).

Cladistic Analysis of the Taxa Included

The present authors have recently completed (in manuscript) a revision of *Diemenia* and *Niarius*. Earlier (1982) they have also revised *Aplerotus* of this group. Gross (1976) has described with beautiful illustrations the genera of his *Diemenia* group. In this light a cladistic analysis of those genera of the *Diemenia* group which have four-segmented antennae is presented. In all, 27 characters, the polarities of which could not unreasonably be deduced, are analysed. No homoplasy had to be invoked.

Characters and Character States

1. *Body patterned* (a): Remarkably patterned body with a prominent transverse luteous stripe at about the level of the apex of scutellum in the members of *Aplerotus* is unique and it is certainly apomorphic, similar to the colour patterns encountered in strachiine Pentatominae which is also an apomorphic condition.

2. *Body oblongate* (b): Pentatomidae are usually oval but elongate (e.g. *Mecidea* Stal) or oblongate (some halyine) – bodied species are very rare and we consider this character of *Grossimenia* apomorphic.

3. *Lateral margins of head produced in front of eyes* (c): This appears to be a unique condition in the entire Pentatominae and is therefore certainly an apomorphy. In *Diemenia, Grossimenia, Niarius* and *Gilippus* species it is very small and lies just in front of the eye, but in *Alphenor* species it extends into an upwardly directed acute lobe lying from just in front of the eyes and thrown up into an erect triangular tooth-like process over the antennifers. The latter condition appears therefore to be a more derived state (c_2 in Fig. 7). In *Boocoris* and *Aplerotus* species this process appears to have been secondarily lost (c_3 in Fig. 7).

4. *Eyes stylate* (d): Throughout Heteroptera the eyes are usually nonstylate, but pedunculate eyes do occur independently in some groups of Trichophora such as in geocorine Lygaeidae, in some largiine Largidae and strachiine Pentatomidae. This condition is certainly apomorphic. *Boocoris* and *Aplerotus* species have slightly or distinctly stylate eyes and appear related, but remarkably pedunculate small eyes also occur in *Gilippus* sp. which appear to be its autapomorphy, but it must have been developed independently.

5. *Antennifers prominent* (e): In Pentatomoidea the antennifers are usually unspinose but in some groups of Podopini such as in *Storthecoris* species, the antennifers are spinose and prominent which is their apomorphy. Similarly all the genera treated in the *Deimenia* group by Gross (1976) have prominent antennifers, mostly spinose, which reflects their synapomorphy but in *Alphenor* species each antennifer is produced into a cordate flat process which appears to be a further derived condition (e_2 in Fig. 7).

6. *Lunate patch in front of ocelli* (f): Unicolourous body is plesiomorphic and in this light the marked dark lunate patch in front of ocelli in *Diemenia* and *Niarius* species is apomorphic.

7. *Broad and medially notched apical margins of paraclypei* (g): In Pentatomidae the paraclypei are round or acute, but broad, truncate or medially notched paraclypei are extremely rare and therefore we consider it autapomorphy of *Gilippus* species.

8. *Antennae four-segmented* (h): In Pentatomoidea the occurrence of five-segmented antennae is very common and must be regarded as plesiomorphic. The occasional four-segmented antennae which occur in some halyines are considered neotenic and therefore apomorphic (Slater pers. comm.).

9. *Second antennal segment remarkably longer than each of the other antennal segments* (i): This is also an extremely rare condition in Pentatominae and probably represents synapomorphies of the presently treated genera (Fig. 7) following Ahmad & Afzal (1988).

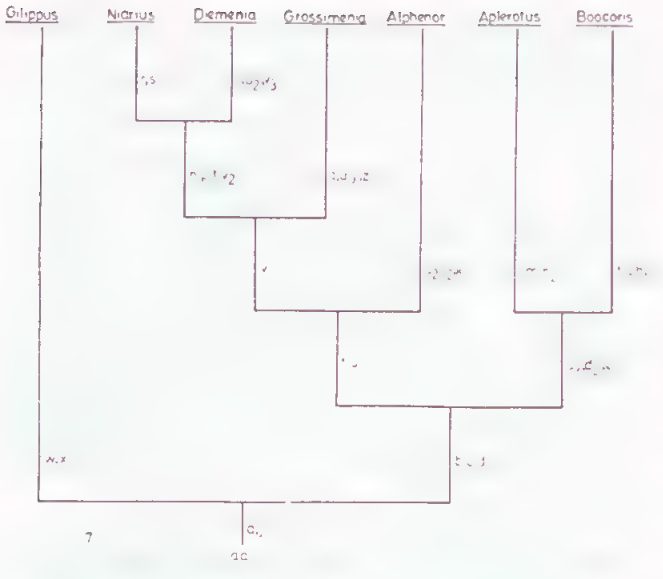


FIGURE 7. Cladogram of the genera included.

10. *Basal antennals clavate* (j): In Trichophora all antennals are usually cylindrical but in some groups e.g. *Mutusca* Stal of the Leptocorisinae and Acestra Dallas of the Micrelytrinae of the Alydidae the basal antennals are remarkably clavate as is the apical segment in most of the Coreidae. This unusual condition reflects their apomorphy and this state in *Boocoris bufiformis* Gross also reflects its autapomorphy.

11. *Labium reaching seventh abdominal venter (k):* In Pentatomidae the labium usually reaches to the hind coxae but the remarkably long labium reaching to the 7th abdominal venter is certainly an apomorphic state in *Grossimenia.*

12. *Lateral margins of pronotum crenulate* (l): Smooth lateral margins occur in the majority of Pentatomidae bugs and where serrations are found, as in most asopine and halyine Pentatomidae, these reflect their apomorphies. Following this argument the presence of crenulations in *Niarius, Diemenia, Grossimenia* and *Alphenor* species reflects their synapomorphies but in *Aplerotus* and *Boocoris* species the loss of crenulations is apparently a reversal of this character and therefore is considered here a further derived trait (l_2 in Fig. 7).

13. *Humeral angles produced* (m): In Pentatomidae humerals are usually rounded but in some groups such as the Asopini and the Halyini, the humerals may be spine-like reflecting their apomorphy following Schaefer & Ahmed (1987). In *Boocoris* sp. the basal third of the anterolateral margins of the pronotum are produced into a prominent, apically bifid, flattened process, arising from the disc and directed outwards at about 45°. The posterior process bordering the bifurcation is the shorter and conical part. This condition certainly represents the autapomorphy of the taxon.

14. *Presence of transverse spines on lateral margins of pronotum* (n): In the Pentatomidae the anterior angle of the pronotum is usually rounded but in most groups of the Phyllocephalinae it is pointed, which appears derived. In *Gilippus* sp. the anterior angles are produced laterally into pronounced transverse spines. Similarly, slightly above anterior to humeral angles on either side of marked acute projections in *Gilippus* sp. reflect autapomorphy.

15. *Scutellum markedly acuminate with posterior lobe remarkably narrow and elongate* (o): In the Pentatomidae the apical lobe of the scutellum is usually short and broad and this condition is plesiomorphic. In *Grossimenia* sp., however, the apical lobe of the scutellum is not only remarkably elongate but markedly narrow with apex acute. This condition is very rare and apomorphic.

16. *Fore-femora armed* (p): In many groups of Pentatomidae such as in most Asopini usually the fore-femora are spinose and this condition has also developed in some lygaeoid, pyrrhocoroid and coreoid species. It certainly reflects the autapomorphy of *Alphenor* species.

17. *Hind-femora surpassing tip of abdomen* (q): In Heteroptera the legs are usually normal in size in proportion to the size of the body, but in certain groups such as in Gerridae and in some Alydidae, the hind legs are much longer than the abdomen with femur surpassing the tip of the abdomen. This is certainly their apomorphy. Following this argument this state in *Boocoris* sp. represents autapomorphy.

18. *Each connexivum bearing spine* (r): In Pentatomidae the connexiva are usually unspinose but in some pentatomids spinose connexiva are reasonably common (e.g. *Alcaeus* Dallas, *Diaphyta* Bergroth, *Morna* Stal, *Petalaspis* Bergroth and *Poecilometis* Dallas). In all these taxa this character (which could be of the same or different origin) appears to be apomorphic. In *Boocoris* sp. each laterotergite bears a strong backwardly-directed or reflexed spine which is unique in the entire group and is certainly apomorphic.

19. *Sides of tergites exposed* (s): In the Pentatomidae the connexiva are usually exposed at repose which is a plesiomorphic trait, but in *Diemenia* species not only the connexiva but the sides of tergites are also exposed, which is certainly an apomorphic state.

20. *Presence of strigose vittae* (t): Presence of strigose vittae is an unusual feature in the Pentatomidae. These are present in only a few groups such as the *Diemenia* group of Gross and in *Knightiella* Ahmad & Khan and *Mecidea.* In these genera they appear to be of different types but in every case they reflect an apomorphic condition.

21. *Median projection of Pygophore (u):* The dorsoposterior margin of the pygophore in the majority of the Pentatomidae is smoothly concave. The prominent trilobed median projection in *Aplerotus* species certainly reflects the autapomorphy of the genus.

22. *Dorsolateral processes of pygophore prominent* (v): These processes are usually rounded in the Pentatomidae but in some advanced Pentatominae, as in some halyines, these are prominent. In *Niarius* and *Grossimenia* species (and also probably in *Alphenor* species whose male genitalia are unknown), these processes are markedly prominent and elongate which condition represents their synapomorphy. In *Diemenia* species, however, these processes are remarkably elongate and apically curved. This feature represents a further derived state (v_2 in Fig. 7).

23. *Paramere with outer spine of the blade prominent* (w): In the species of three genera viz. *Grossimenia, Niarius* and *Diemenia*, there is a spine on the outer surface of the blade which is very rare in the Pentatominae and represents synapomorphy of the group. In *Grossimenia* sp. the spine is transversely directed and is slightly below the level of the apex of the short blade which gives a T-like appearance to the paramere. In *Niarius* and *Diemenia* species the spine is arch-like and is at the level of the apex of the blade, which is a more derived character and gives it an L- or y- shape (w_2 in Fig. 7). In *Diemenia* species the spine is distinctly more pronounced and gives the paramere a y-shaped appearance, which is considered here to be further derived (w_3 in Fig. 7).

24. *Complex dorsal membranous and other sclerotised conjunctival appendages* (x): The dorsal membranous conjunctival appendages in the majority of the Pentatomidae is simple, and bilobed as in *Niarius* and in *Grossimenia* species. In *Diemenia* species it is usually very complicated, many-branched and reflects autapomorphy. In *Aplerotus* species the presence of many sclerotised conjunctival appendages reflects a further derived condition (x_2 in Fig. 7).

25. *First gonocoxae concealing most of the remaining parts of ovipositor* (y): In the Trichophora the genitalia are usually exposed but in the Pyrrhocoroidea these appear concealed, which condition was considered apomorphic by Ahmad & Schaefer (in manuscript). Following that argument the concealment of most of the ovipositor by the first gonocoxae in *Niarius* species is certainly an apomorphic state.

26. *Spermathecal bulb markedly elongate* (z): In the Pentatomidae the spermathecal bulb is usually oval or oblong, which condition reflects plesiomorphy, but in *Niarius* species the spermathecal bulb is usually elongate and slender which is certainly a derived state.

27. *Processes on the spermathecal bulb* (aa): In primitive Pentatomoidea (Ahmad 1979) the spermathecal bulb is usually simple without finger-like processes but in some groups of advanced Pentatomidae such as in Carpocorini and Halyini, finger-like processes are present on the spermathecal bulb, which represents the apomorphic state similar to that in *Diemenia* and *Niarius* species. When the spermathecae of *Grossimenia* and *Alphenor* species become available they may also be found to possess these processes.

Discussion of Cladogram (Figure 7)

Gilippus (with five-segmented antennae) exhibits sister group relationships with the above genera of the *Diemenia* group (having four-segmented antennae) in possessing lateral lobes on the head in front of the eyes. The cladogram predicts that the spermatheca of *Grossimenia*, and also probably of *Alphenor,* will be found to possess finger-like processes on the spermathecal bulb.

The genera *Aplerotus* and *Boocoris* apparently form a group in exhibiting loss of the lateral process of the head in front of the eyes, and in the crenulation of the lateral margins of the pronotum. Similarly the eyes in both are on upwardly and slightly outwardly directed peduncles. In *Gilippus* species the eyes are also pedunculate, but here the eyes are small and the stalk appears more prolonged and must be considered of a different type.

The cladogram shows *Niarius, Diemenia* and *Grossimenia* closely related and *Alphenor* to exhibit a sister group relationship with these genera. The male genitalia of *Alphenor* are unknown but the cladogram predicts that when these become available they will be found to possess lateral lobes of the pygophore.

Acknowledgment

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A REASSESSMENT OF THE AUSTRALIAN SPECIES OF *MENEPHILUS* MULSANT (COLEOPTERA: TENEBRIONIDAE) WITH DESCRIPTIONS OF TWO NEW GENERA AND A LARVA AND PUPA

E. G. MATTHEWS & J. T. DOYEN

MATTHEWS, E.G. & DOYEN, J.T. 1989. A reassessment of the Australian species of *Menephilus* Mulsant (Coleoptera: Tenebrionidae) with descriptions of two new genera and a larva and pupa. *Rec. S. Aust. Mus.* 23(1): 39–50.

Among the Australian species previously assembled under the generic name *Menephilus* Mulsant are three natural genera. One is *Tetragonomenes* Chevrolat (Coelometopinae) with five named Australian species not revised here. Two are new and described as *Kaszaba* gen. nov. (Coelometopinae) and *Bassianus* gen. nov. (Tenebrioninae), each with four named species. New combinations are: *Tetragonomenes aeneus* (Carter), *T. azuripennis* (Carter) and *T. ruficornis* (Champion); *Kaszaba coerulescens* (Haag-Rutenberg), *K. corvina* (Erichson), *K. laeta* (Carter) and *K. pulchra* (Carter); *Bassianus colydioides* (Erichson), *B. humilis* (Erichson), *B. rectibasis* (Carter) and *B. sydneyanus* (Blackburn). *B. armstrongi* (Carter) is newly synonymised with *colydioides* (Erichson). The affinities of the new genera are discussed and their species keyed and briefly reviewed. The larva of *Bassianus rectibasis* and the pupa of *B. sydneyanus* are described and compared with larvae of related genera and the tribe Heleini.

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Confusion has attended the use of the generic name *Menephilus* Mulsant in Australia from its first application by Macleay (1872) to his new *parvulus* (= *colydioides* Erichson) and to *nigerrimus* Boisduval (a *nomen dubium* possibly in the genus *Zophophilus* Fairmaire). Altogether, species belonging to five different genera have at one time or another been described in, or assigned to, *Menephilus* in Australia. None of these are currently considered to be congeneric with the European type species *M. cylindricus* Herbst. However, *Zophophilus* (= *Teremenes* Carter), with four Australian species, is very close to *Menephilus* (Doyen *et al.* in press).

Carter's (1926) checklist of the Australian Tenebrionidae still contained elements of three different genera in *'Menephilus'* and it is our purpose in the present paper to sort out the species included and assign them to their correct genus. Two of the latter are new and are dealt with below. The third is *Tetragonomenes* Chevrolat (1878), subsequently redescribed as *Obriomaia* Gebien (1927) [*see* Kaszab (1983) for synonymy].

It is not our intention to revise the species of *Tetragonomenes* here and we have not examined the relevant types. It is clear from descriptions and identified material, however, that the following Australian specific names belong in this genus: *aeneus* Carter (1905), comb. nov., *azuripennis* Carter (1914), comb. nov., *intercoxalis* Kulzer (1951), *ocularis* Kulzer (1951), and *ruficornis* Champion (1894), comb. nov. It is unlikely that all of these names are valid.

Tetragonomenes is an Indo-Malayan genus of Coelometopinae and like all Australian members of this subfamily it represents the 'younger northern element' of the Australian fauna [*sensu* Mackerras (1970)]. Even so, it has penetrated the continent along the east coast as far south as Tasmania and along the south coast to Western Australia.

The other two elements in *'Menephilus'* include one other coelometopine, here named *Kaszaba* gen. nov., which has likewise reached Tasmania but which is not known west of central Victoria. It occurs in northern Australia but as yet we have not seen any Papuan or Indo-Malayan species which can be assigned to it. The third element is unrelated to the previous two and belongs to the Tenebrioninae, Tenebrionini. In Australia the native Tenebrionini are a Bassian group concentrated in the south-east but extending, with diminishing representation, as far north as New Guinea. We have named the tenebrionine genus *Bassianus* gen. nov. to highlight its southern origins.

That such disparate elements could hitherto have been confused under a single generic name reflects external morphological convergence, probably due to a similarity of habitat. From scant label data and our own observations, it appears that *Tetragonomenes*, *Kaszaba*, and *Bassianus* are all found under the bark of fallen trees and rotten logs in forests. In some cases members of different genera share exactly the same label data, indicating that they were found together.

We studied the original type material of all the 11 specific names in *Kaszaba* and *Bassianus* and

material from most major Australian collections. The following acronyms are used to identify the collections consulted:

AMSA Australian Museum, Sydney
ANIC Australian National Insect Collection, Canberra
BMNH British Museum (Natural History), London
EMUC Essig Museum, University of California, Berkeley
HCOE Hope Entomological Collections, University Museum, Oxford
MNHB Museum für Naturkunde der Humboldt-Universität, Berlin
MVMA Museum of Victoria, Melbourne
QMBA Queensland Museum, Brisbane
SAMA South Australian Museum, Adelaide
UQBA Department of Entomology, University of Queensland, Brisbane
ZSSM Zoologische Staatssamlung, Munich.

Systematics

Kaszaba gen. nov.

Type-species: *Tenebrio corvinus* Erichson, (1842).

Description of adult

General appearance: Oblong. Piceous, usually with metallic reflections. Total length 7–15 mm.

Head: Epistoma with anterior edge straight or feebly concave, its suture complete, indistinct, not impressed, arcuate. Eyes small to moderate, globose, separated by a distance equal to 2.5–5 eye widths. Canthus feebly developed. Head surface finely, densely punctate, glaborous. Bridge of tentorium arcuate. Labrum transverse. Mandibles bidentate apically. Lacinia with uncus. Maxillary palpi with terminal segment subtriangular or truncate-oval. Mentum trapezoidal, with a very prominent, rounded median longitudinal ridge. Antennae short, not reaching base of prothorax, segments gradually enlarging apically, with scattered tenebrioid organs (complex sensoria) on apical segments.

Prothorax: Subquadrate in outline, lateral edges feebly sinuate. Anterior angles broadly rounded, not prominent. Posterior angles subquadrate. Base feebly produced medially. Pronotum margined except along middle of anterior edge; disc convex, more so anteriorly, finely punctate, glabrous. Prosternum without median keel, process only feebly expanded and rounded apically, not prolonged. Coxal cavities closed both externally and internally.

Pterothorax: Humeri wider than base of prothorax. Elytra with nine deep striae and scutellary striole; strial punctures deep, crenulating edges of intervals, which are convex, smooth, extremely finely punctate and glabrous. Epipleura narrow, terminating opposite penultimate sternite where they bear a deep groove to receive edges of latter. Mesosternum shallowly excavated, finely and densely setose. Mesepimera reaching mid-coxal cavities. Wings without subcubital fleck, with normal tenebrionid venation (*see* Matthews 1986).

Legs: Front femora of average proportions. Tibiae gradually expanded apically, not dentate, apical spurs very short. Tarsal segments, except apical, short, penultimate cupuliform, with long dense setae beneath, including claw segment. Claws unmodified.

Abdomen: Intercoxal process of basal sternite triangular. Upper edge of apical sternite grooved to receive elytra. Defensive reservoirs very large and reinforced by helical thickenings. Female genital tract of advanced coelometopine type (Tschinkel & Doyen 1980), without bursa and with globose spermatheca at apex of long spermathecal tube (Fig. 3). Ovipositor very long, of coelometopine type with transverse paraprocts (Fig. 3). Aedeagus with parameres slender and tapering, largely fused, comprising $^2/_5$ of total aedeagal length, enveloping median lobe, without setae.

Sexual dimorphism: Evident only on front femur, which in the male bears a small, linear lenticular tomentose patch in the middle of inside face.

Remarks

Kaszaba clearly belongs to the Coelometopinae, especially in the structure of the female genital tube (Fig. 3), which is of the typical advanced coelometopine type (Tschinkel & Doyen 1980), in the enlarged, annulate defensive reservoirs, and the transverse paraprocts of the ovipositor. Externally coelometopines are difficult to distinguish from certain Tenebrioninae, especially the Tenebrionini. About the only consistent character is the presence of complex antennal sensoria in the former and not in the latter.

Within the Coelometopinae, *Kaszaba* is recognised by a combination of the incomplete elytral epipleura, the feeble pro-mesosternal locking mechanism, rounded anterior pronotal angles, cupuliform penultimate tarsal segments, and fully developed hind wings with normal tenebrionid venation (not the 'coelometopine venation', *see* Matthews 1986). It comes closest to *Espites* Pascoe in diagnostic characters but has an elongate, *Tenebrio*-like form and uniform coloration. Superficially *Kaszaba* most closely resembles *Tetragonomenes*, but the latter does not have cupuliform tarsal segments, the lateral pronotal margin is irregularly dentate, the pronotal disc is more convex and coarsely punctate, the median keel of the mentum is sharp (not rounded) and less

prominent, and in the male there is no setal patch on the inner front femoral surface.

The species of *Kaszaba* are closely related and can be separated with difficulty only on the basis of superficial features of colour, proportions and size. No genital differences could be found.

The genus is named in honour of the late Dr Zoltán Kaszab in recognition of his important contribution to knowledge of Pacific Tenebrionidae.

KEY TO THE SPECIES OF *KASZABA*

1. — Without or with only the faintest trace of metallic reflections; pronotum subquadrate, little broader anteriorly; eyes small, separated by about four times their width when seen from above (Fig. 28); total length 7–11 mm. Victoria to Queensland ..... *coerulescens* (Haag-Rutenberg)
— With distinct blue, green or purple reflections; other characters not present in same combination 2

2(1) — Pronotum subquadrate, length to width ratio about 1 : 1.2, little broader anteriorly; eyes small, separated by about five times their width (Fig. 29); total length 10–15 mm. Tasmania to southern Queensland ..... *corvina* (Erichson)
— Pronotum transverse, about 1.4 times as wide as long; eyes larger; total length not over 13 mm 3

3(2) — Total length 10–13 mm; pronotum slightly narrowing anteriorly; eyes separated by about four times their width (Fig. 30). Cairns district, Queensland ..... *laeta* (Carter)
— Total length 8–10 mm; pronotum slightly widened anteriorly; eyes larger, separated by 2.5–3 times their width (Figs 31, 32). Northern Queensland and Northern Territory ..... *pulchra* (Carter)

Kaszaba coerulescens (Haag-Rutenberg) comb. nov.
(Figs. 1, 3, 5, 28)

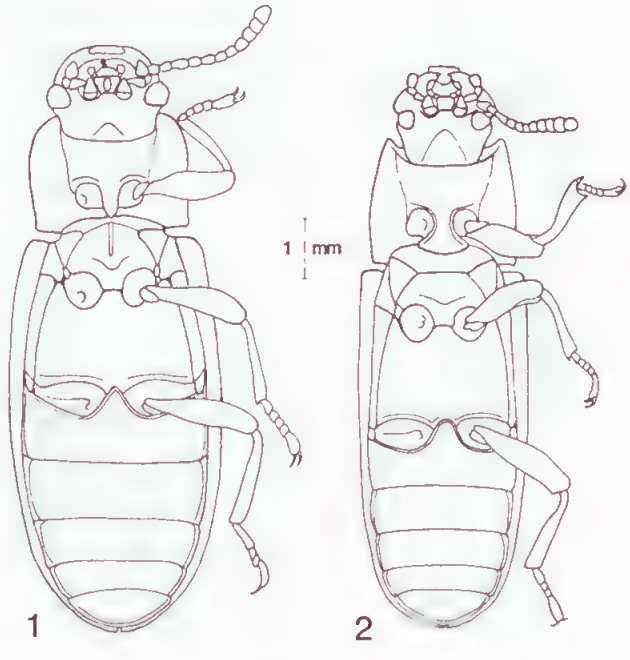
Menephilus coerulescens Haag-Rutenberg 1878: 100; Haag-Rutenberg 1879: 122; Carter 1914: 52, 53; Carter 1926: 146.

Types

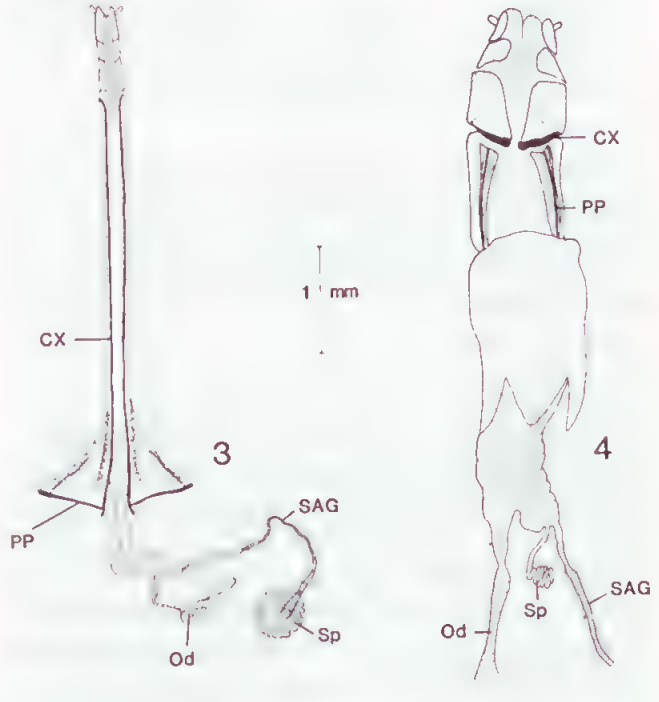
The provenance of the species is given by Haag-Rutenberg (1878) as Cape York and New South Wales. The type series in ZSSM consists of six specimens, all the same species. The specimen bearing Haag's identification label *'coerulescens m.'*, a female, is designated lectotype. It also bears the labels: 'cotype *Meneph. coerulescens* H.R.' and 'N. Holl. Dollé'. The other five specimens are designated paralectotypes and are labelled as follows: 'Austr. bor. Godefr.' (1♂); 'N.S. Wales Baulng' (2♂♂); 'N. Holl. Parz.' (1♀); 'Cp. York Telfing' (1♀).

Distribution

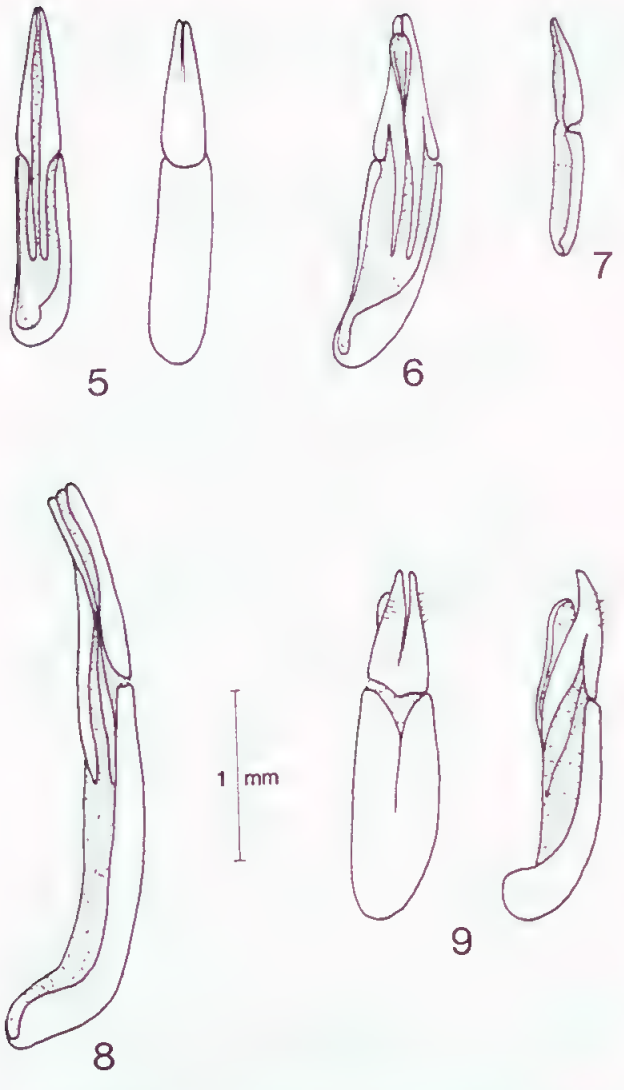
Coastal Victoria from the Melbourne area eastward, New South Wales mostly east of the Great



FIGURES 1 & 2. 1. *Kaszaba coerulescens*, venter. 2. *Bassianus colydioides*, venter.



FIGURES 3 & 4. Female genital apparatus. 3, *Kaszaba coerulescens*. 4, *Bassianus sydneyanus*. CX — baculus of coxite; PP — Baculus of paraproct; Od — oviduct; SAG — spermathecal accessory gland; Sp — spermatheca.



FIGURES 5–9. 5, aedeagus of *Kaszaba coerulescens*, ventral (left) and dorsal (right). Aedeagi of *Bassianus*: 6, *B. sydneyanus*. 7, *B. colydioides*. 8, *B. humilis*. 9, *B. rectibasis*, dorsal (left) and lateral view (right).

Dividing Range, south-eastern Queensland, and possibly isolated populations known from central Queensland at Eungella, west of Mackay, and the Atherton Tableland. The single specimen in the type series labelled Cape York is the only one known from that area.

Remarks

This is by far the most frequently collected species in the genus and has always gone correctly under the name *coerulescens* in collections despite that it is not bluish as Haag implied in the name and stressed in the description and remarks. It shows only a very faint trace of blue colour when wetted. In all other respects the type specimens agree with the original description.

Material examined

Two hundred and eighteen specimens. Victoria: Bacchus Marsh district; Beaconsfield; five miles N Cann R., swamp forest; Chiltern; Gippsland; Healesville; Lakes Entrance; Melbourne; Mitchell Gorge; Narracan; Noble Park; Ringwood; Traralgon; Tyers; Victorian Alps; Warburton. Australian Capital Territory: Brindabella Range, Old Mill Rd, 2 775'. New South Wales: Bathurst; Black Heath; Blue Mts; Brown Mt; Bundjalong N.P., Black Rocks; Deep Creek; Dorrigo; Duggan's Gully, Upper Chichester; Eccleston; Forest Reefs; Galston; Gibraltar Range N.P.; Gosford; Hastings River; Jenolan S.F.; Lilyvale; McArthur's Clearing nr. Kempsey; 4–8 km SW Lake Cathie; Lowden Forest Park; Mittagong; 15 km NW Moruya; Mt Kaputar N.P., Dawsons Spr., 3 500–4 500'; Moss Vale; National Park; Penrose S.F.; Poverty Point 20 km SE Tenterfield; Richmond River; Seven Mile Beach; Sydney; Tweed River; Ulong; East Dorrigo; Upper William River; Uralla, 1 mile W of river crossing; Walcha; Wentworth Falls; Yetholm. Queensland: Acacia Ridge; Bald Mt area via Emu Vale, 3–4 000'; Blackall Range; Broken River, Eungella; Bunya Mts.; Cunningham's Gap N.P., 4 miles W Cunningham's Gap; Dunwich, N. Stradbroke I.; Eukey; Gatton; Kroombit Tops, 45 km SSW Calliope; 12 km N Kuranda; MacPherson's Range; Mapleton; Mt Tamborine; 18 mi N Quinalow; Stanthorpe; Sugarloaf. Logs, open forest, rainforest, dry sclerophyll. All months of the year. AMSA, ANIC, EMUC, MVMA, QMBA, SAMA, UQBA.

Kaszaba corvina (Erichson), comb. nov.
(Fig. 29)

Tenebrio corvinus Erichson, 1842: 175.
Menephilus corvinus, Champion 1894: 390; Carter 1914: 52; Carter 1926: 146.
Tenebrio cyanipennis Hope 1843: 360; Hope 1845: 111; Champion 1894: 390 (syn).

Types

Of *corvina*: Van Diemen's Land. A single female in MNHB bears the labels '*corvinus* Er.' and 'Terr. van Diem. Schayer', and the number 45958. It is here designated lectotype. Of *cyanipennis*: a single male, somewhat damaged, bearing the labels 'TYPE HOPE Proc. Ent. Soc. 1842 p. 79 Coll. Hope Oxon' and '*cyanipennis* Hope N. Holl, Type Coll. 1102' (HCOE). The citation and date appearing on the first label is the one that is frequently quoted in catalogues but it is incorrect, since those Proceedings of the Entomological Society were not published until 1843.

Distribution

Tasmania, mountainous areas of Victoria, New South Wales, and extreme southern Queensland. The species was recorded from South Australia by

Champion (1894) and Carter (1914, 1926), apparently on the basis of the title of Hope's 1845 paper redescribing *cyanipennis*. However, in the latter work Hope described many species which were clearly not from Adelaide and there is no indication of where *cyanipennis* was collected. We have not seen this species from west of Macedon, Victoria.

Material examined

Twenty-four specimens. Tasmania: Brown's River; Hobart; Launceston; Mole Creek; Swansea. Victoria: Alps; Buffalo River Preserve; Macedon; Melbourne District. Australian Capital Territory: Brindabella Rge., Piccadilly Circus, 3 650'. New South Wales: Blue Mountains; Brown Mountain; Ebor; 30 km S Glen Innes; Tooloom Plateau *via* Urbenville. Queensland: Stanthorpe. Jan. Feb. Apr. Oct., Nov. AMSA, EMUC, MVMA, QMBA, SAMA, UQBA.

Kaszaba laeta (Carter) comb. nov.
(Fig. 30)

Menephilus laetus Carter 1914: 69; Carter 1926: 146.

Types

Kuranda, North Queensland, MVMA. There are two specimens in the type series, a male and a female of the same species, both labelled 'Kuranda Dodd', and bearing the numbers T–4092 and T–4091 respectively on separate red labels. The female also bears the label in Carter's hand '*Menephilus laetus* Carter 10–11–12'. The female, No. 4091 (identified as a male) is in better condition and is hereby designated lectotype, and the male, allolectotype.

Distribution

Known only from the Atherton Tableland in north Queensland.

Material examined

Eight specimens. Queensland: Cairns District; Mareeba; Ravenshoe. July (3). MVMA, QMBA, SAMA.

Kaszaba pulchra (Carter), comb. nov.
(Figs 31, 32)

Menephilus pulcher Carter 1924: 36; Carter 1926: 146.

Type

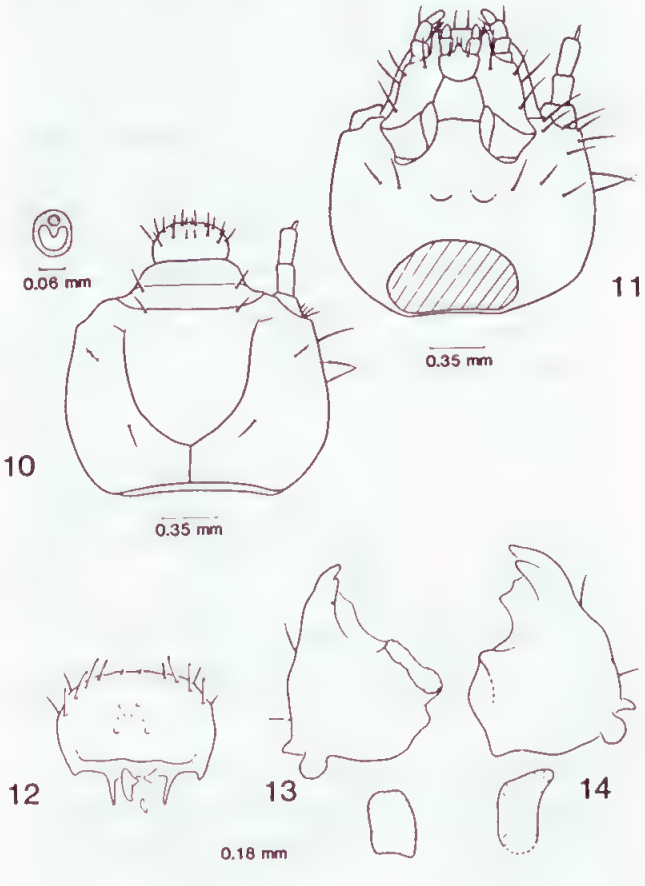
North Queensland: Deeral. J.F. Illingworth, scrub. AMSA K67235. A single female with the abdomen missing, designated holotype by Carter (1924). Deeral (17°13'S, 145°55'E) is a station on the railway which parallels Highway One, approximately halfway between Gordonvale and Babinda.

Distribution

Along the coast and on offshore islands, from Bowen (Port Denison) to Cairns, north Queensland and the northern end of the Northern Territory.

Remarks

Queensland specimens have the elytra green with the lateral three or four intervals golden, whereas the three Northern Territory specimens known have uniformly purple elytra. The latter also have slightly smaller eyes in dorsal view (Fig. 32). Material is insufficient for us to decide whether the Northern Territory form is a separate species.



FIGURES 10–14. *Bassianus rectibasis*, larva. 10, head, dorsal aspect, mandibles and left antenna removed. Dashed line indicates eye spots. Inset shows apical view of 2nd antennal segment. 11, same, ventral aspect. 12, labrum (epipharynx), ental aspect. 13,14, right and left mandibles, ventral aspect, with normal view of molar surfaces below.

Material examined

Thirteen specimens. Queensland: Bowen; Cairns; Magnetic Island; Mary Creek; Palm Island; Port Denison. Northern Territory: Groote Eylandt; South Alligator Inn. May (1). AMSA, EMUC, SAMA, UQBA.

Bassianus gen. nov.

Type-species: *Tenebrio colydioides* Erichson, 1842.

Description of adult

General appearance: Oblong. Entirely piceous. Total length 6–13 mm.

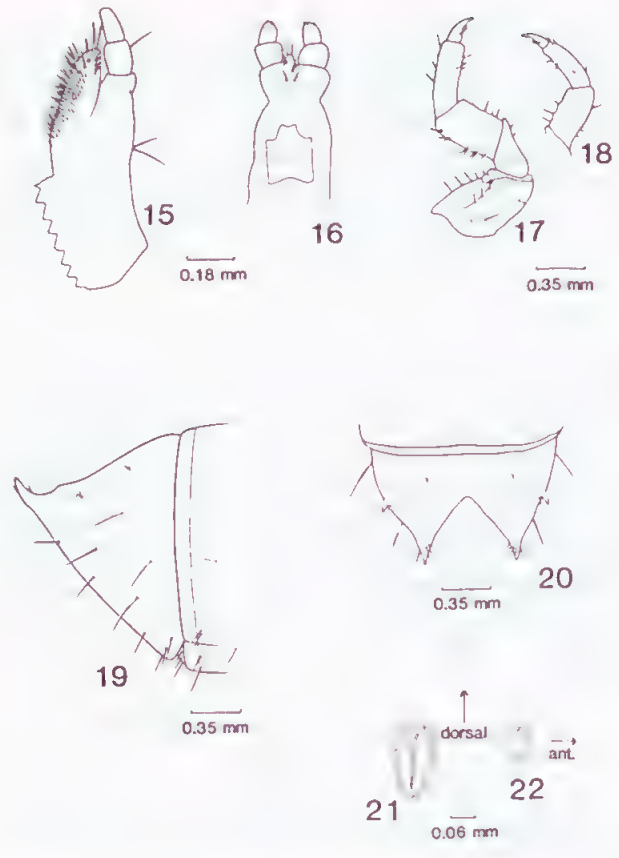
Head: Epistoma with anterior edge shallowly concave, suture ill-defined, arcuate. Eyes small, inwardly with a straight edge, separated by distance equal to 3.5–5 eye widths, canthus well developed. Head surface densely punctate, glabrous. Bridge of tentorium flat, straight. Labrum transverse. Mandibles bidentate apically. Lacinia with uncus. Maxillary palpi with terminal segment oval or subtriangular. Mentum trapezoidal, without median keel or with feeble one. Antennae short, not reaching base of prothorax, apical four or five segments somewhat widened, without complex sensoria.

Prothorax: Subquadrate to trapezoidal in outline. Anterior angles strongly projecting forward. Posterior angles subquadrate or subacute. Base sinuate or straight. Pronotum finely margined except along middle of anterior edge, disc evenly convex, finely to moderate punctate, glabrous. Prosternum without median keel, process strongly expanded apically, not prolonged. Coxal cavities closed externally, open internally.

Pterothorax: Humeri little wider than base of prothorax, more or less grooved basally to receive prothorax. Elytra with 9 shallow, coarsely punctate striae and scutellary striole. Intervals feebly convex, impunctate and glabrous. Epipleura narrow, complete to apices. Mesosternum strongly stepped to receive prosternum. Mesepimera reaching mid-coxal cavities. Metendosternite Y-shaped, without laminae. Wings with subcubital fleck, sometimes faint.

Legs: Front femora relatively massive. Tibiae gradually expanded and with dense setae apically, not dentate, apical spurs very short. Tarsal segments, except apical, short, not cupuliform, with long dense setae beneath all except claw segment, which has only sparse setae, claws unmodified.

Abdomen: Intercoxal process of basal sternite U-shaped or rounded-triangular, upper edge of apical sternite not grooved. Defensive reservoirs small, without annuli. Female genital tract of tenebrionine type (Tschinkel & Doyen 1980), without bursa, with strongly coiled spermatheca at end of short branch diverging from non-glandular basal portion of the accessory gland (Fig. 4). Ovipositor short, of tenebrionine type with longitudinal paraprocts (Fig. 4). Aedeagus with parameres basally fused, slender and tapering, setose, comprising nearly half of total aedeagal length, enveloping median lobe. Median lobe with two reinforcing rods (Figs 6–9).



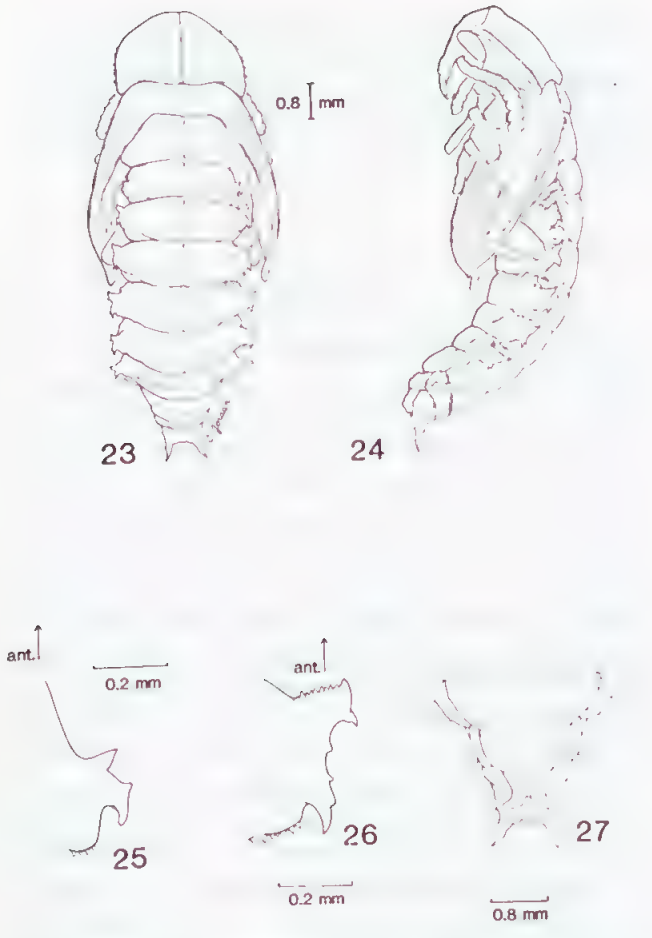
FIGURES 15–22. *Bassianus rectibasis*, larva. 15, left maxilla, ventral aspect. 16, hypopharynx, dorsal. 17, 18, prothoracic and mesothoracic legs, posterior aspect. 19, abdominal apex, lateral. 20, abdominal apex, dorsal. 21, 22, right mesothoracic and second abdominal spiracles. Crenulate margin is posterior.

Sexual dimorphism: Evident in shape of hind leg of male, with femur posteriorly concave in outline and bearing a small tooth or angle distally, trochanter usually dentate, and tibia sometimes apically bent. Male *B. sydneyanus* also have a short tomentose line on inner edges of all femora, and fore tibia apically bent.

Description of late instar larva (based on *rectibasis*).

General appearance: Body subcylindrical, moderately sclerotized. Brownish. Total length 12–14 mm.

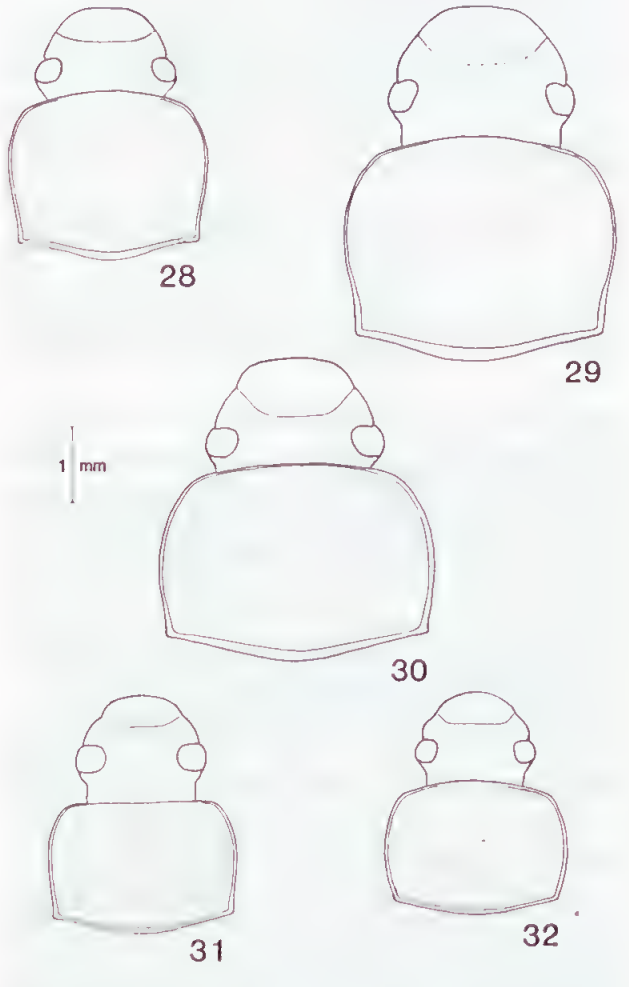
Head: Slightly flattened, deflexed at rest, with mouthparts directed anteroventrally. Cranium medium brown, coarsely punctate. Epicranial stem length about 0.15 times head width; frontal arms very briefly bifurcate at apex, not reaching frontoclypeal suture (Fig. 10), endocarina absent. Lateral ocelli consisting of three pigment spots arranged in vertical row just behind antennal articulation and single spot (or two poorly separated spots) posterodorsal to row of three; cuticle colorless above eyespots, but not modified as lens. Cranial setae consisting of one pair at corners of clypeus, one pair just behind clypeofrontal suture,



FIGURES 23–27. *Bassianus sydneyanus*, pupa. 23, dorsal aspect of pupa. 24, lateral aspect of pupa. 25, 26, right lateral lamellae (gin traps) of abdominal segment I and II. 27, abdominal apex, ventral.

two dorsal pairs, lateroventral patches of about 7–8 setae on each side and line of about five setae between eye spots and antennal base (Figs 10, 11). Clypeus with posterior half rigidly sclerotized, pigmented; anterior half flexible, densely set with asperities. Gular sutures incomplete posteriorly; tentorial pits aligned horizontally (Fig. 11). Antenna three–segmented; articular membrane expansive, allowing partial antennal retraction, and set with minute asperities; antennal segment two slightly longer than first; sensorium broadly U-shaped, partially encircling base of peg-like third segment. Labrum about 1.5 times broader than long, bearing transverse row of about six setae across middle and apical fringe of about 10 setae (Fig. 10); tormal arms slender, almost straight; epipharynx with marginal row of eight bristles, two marginal peg-like setae, one pair of submarginal and four pairs of central, annular sensilla; single masticatory process on right, several smaller processes on left. Mandibles (Figs 13, 14) with apices bifid; retinaculum a low carina on right mandible; bidentate, prominent process on left, separated from incisor lobe by deep cleft; molar lobes prominently elevated, right concave, left with prominent anteroventral tooth and strong dorsal ridge; ectal mandibular surfaces each with two setae. Maxilla (Figs 11, 15) with articulatory area elongate, clearly demarked from cardo; mala with double row of spines on medial surface, scattered finer, shorter setae on ectal surface. Labium with prementum trapezoidal, slightly broader than long, bearing seta at base of each palp, six setae dorsally and apically on ligula (Figs 11, 16); mentum irregularly hexagonal, about as long as wide; submentum not distinct from gula; hypopharyngeal sclerome with four-lobed anterior margin, dorsal surface very weakly concave.

Thorax: With pronotum about twice as long as mesonotum, anterior sixth of prothorax slightly constricted, longitudinally striolate dorsally, becoming finely granulose ventrally and continuous with sternite; posterior eighth of tergite forming finely granulose border; central portion of tergite coarsely, sparsely and shallowly punctate; laterotergite separated from tergite by carina, from sternal region by infolding, but continuous with anterior marginal region, finely granulose; sternite finely granulose, strongly involuted in anterior third,



FIGURES 28–32. Dorsal outlines of head and pronotum of *Kaszaba*. 28, *K. coerulescens*. 29, *K. corvina*. 30, *K. laeta*. 31, *K. pulchra*, Queensland form. 32, *K. pulchra*, Northern Territory form.

forming subvertical surface against which deflexed head rests. Tergite with row of about eight long, slender setae along lateral margin, few short setae on disc; laterotergite with about five setae in longitudinal row; sternite with pair of anterolateral setae and one pair centrally. Mesothorax and metathorax similar to prothorax, but tergite without anterior striolate border. Prothoracic leg slightly larger, legs otherwise similar (Figs 17, 18), coxa with row of setae along anterior and posterior borders of ectal surface; femur and tibia with few short setae on ectal surface; trochanter with two, femur with three and tibia with four short setae on ental surface, apical two on tibia stouter; claw with pair of ental setae.

Abdomen: Segments 1–7 similar to metathoracic, but tergites with one anterior and one posterior short seta on lateral margins; laterotergites with one short seta at anterior fifth, sternites with single anterior and two posterior setae near each lateral margin, except sternite one, which has band of about 20 setae along anterior margin. Segment 8 similar, but with 2 posterolateral setae and one seta more dorsally near posterior margin (Fig. 19). Tergite 9 very much larger than narrowly transverse sternite (Fig. 19); deeply bifid posteriorly and produced as slightly upcurved prongs, and bearing pairs of nonarticulated spur-like processes on each side (Figs 19, 20); short setae situated near each process and around apices of prongs; long, slender setae distributed ventrolaterally and laterally on tergite and across sternite. Pygopods not visible.

Spiracles: (Figs 21, 22) with posterior margins crenulate; mesothoracic elliptical with about eight distinct, deep crenulations; abdominals very broadly elliptical with three or four distinct crenulations.

Description of pupa (based on *sydneyanus*)

General appearance: uniformly pale brown. Without setae. Total length 9 mm.

Head: Bent posteroventrad, invisible from above (Figs 23, 24); antenna held below prothoracic and elytral margin, just above front legs; segments 5–10 distinguished by annuli of blunt, non-articulated tubercles, largest dorsally and on apical segments; segment 11 with tubercles over entire surface.

Pronotum: With few tubercles along lateral margins; hypomeron with tooth like process protruding between antenna and profemur. Elytra and hindwings held between meso- and metathoracic legs; elytra with nine striae.

Abdomen: Tergites 1–7 produced as large lateral lamellae; lamella on segment 1 (Fig. 25) with weak anterior and strong posterior tooth; those on segments 2–6 with strong anterior and posterior teeth; anterior margin minutely serrate; lateral and posterior margins finely, irregularly dentate. Lamella on segment 7 with anterior corner angulate, then arcuately receding posteriorly, with two marginal teeth; segment 8 with margin moderately explanate but unarmed. Sternites 7 and 8 with few weak tubercles along posterior margins. Tergite 9 produced as attenuate posterior processes; sternite 9, as much shorter, blunter processes.

Remarks

The structure of the female genital apparatus (Fig. 4) places this genus unequivocally in the Tenebrionini. It is in many respects similar to *Tenebrio* Linnaeus but does not have the spinulose connecting membrane of the aedeagus which is the principal apomorphism of the latter. As in some *Tenebrio* it has internally open procoxal cavities, a plesiomorphous feature shared with Heleini and Cyphaleini, with which it also shares (in part) the plesiomorphous subcubital fleck on the wings, absent in *Tenebrio*. Most of the above characters are found in the other native Australian Tenebrionini: *Meneristes* Pascoe, *Sloanea* Carter, and *Asphalus* Pascoe. *Bassianus* may be distinguished from all of these by the combination of the absence of a longitudinal groove on the outer faces of the tibiae and smaller size, and from all but *Meneristes* by the presence of wings. Separation of Tenebrionini, Heleini and Cyphaleini is discussed in Doyen *et al.* (in press) and in papers in preparation by the authors.

From the superficially similar but unrelated coelometopine genera *Tetragonomenes* and *Kaszaba*, with which it has been confused, adult *Bassianus* may be distinguished most easily by the absence of complex antennal sensoria, advanced anterior pronotal angles, distally expanded prosternal process, and complete elytral epipleura.

Watt (1974) distinguished larval Heleini and Cyphaleini from other tribes of Tenebrioninae on the basis of spiracular structure: peritreme crenulate in Heleini and Cyphaleini, simply annular in other tribes. He also remarked that larvae of *Meneristes* and *Asphalus*, though usually placed in Tenebrionini, which the adults resemble, have crenulate spiracles. Larvae of *Bassianus* have the spiracular peritreme crenulate, but only on the posterior side, and in the abdominal spiracles only three or four crenulations are visible.

An additional feature which may differentiate many larval Heleini and Tenebrionini is the structure of abdominal segment nine. In Tenebrionini (*Tenebrio, Neatus* Leconte, *Alphitobius* Stephens, *Zophobas* Blanchard) sternite 9 is about one quarter as long as the tergite, and large pygopods are usually extruded in preserved specimens. In Heleini, as noted by Allsopp (1979), the sternite is much smaller, usually about one eighth to one tenth as long as the tergite. In Heleini pygopods are very small and rarely visible

in preserved specimens. In these features Heleini more closely resemble Ulomini.

Larval Heleini we have examined have the gular sutures very faint in the posterior half and not reaching the occipital foramen. In *Tenebrio* and *Neatus* the sutures may be somewhat faint posteriorly, but extend to the foramen. In *Zophobas*, however, the sutures are reduced to the tentorial pits, as in *Bassianus*.

Other characteristics, such as the shape of the antennal sensorium, configuration of epipharyngeal sensory organs, or structure of tergite 9 (Doyen *et al.* in press), may prove to be of value for these larvae, but much more extensive comparisons are required.

The genus most similar to *Bassianus* in larval features is *Meneristes* (Watt 1974). They share the large urogomphi on tergite 9, as well as exceedingly similar mouthpart and leg structures. In *Bassianus*, in addition to the large urogomphi, there are five other pairs of non-articulated spurs on the dorsolateral to ventrolateral surfaces of the tergite. In *Meneristes* there are only two lateral pairs of spurs. In *Bassianus* the antennal sensorium is U-shaped, whereas in *Meneristes* it is three-lobed. The epipharynx of *Meneristes* bears a pair of stout, short spines behind the patch of annular sensoria; in *Bassianus* the spines are absent. Finally, in *Bassianus* the legs are slightly more slender, with a comb of three or four tibial setae; in *Meneristes* there are five or more tibial setae, at least in later instars.

The general pupal form and the shape of the gin traps of *Bassianus* are similar to those of *Meneristes*. However, in *Meneristes* the pupal antennae lack the annuli of tubercles present in *Bassianus*. Pupal antennae of Tenebrioninae are not known to be tuberculate. This feature has not yet been examined in enough Heleini or Cyphaleini to speculate on its uniqueness.

The species of *Bassianus* are distinct and readily separated on external morphological characters. Minor genitalic differences could be found in the relative shape of the aedeagus (Figs 6–9). In addition, *rectibasis* bears long setae on the parameres, which in the other species are only minutely setulose.

Key to the Species of *Bassianus*

1. — Base of pronotum strongly sinuate, very shallow transverse basal depression often present on disc (Fig. 33), inflected portions wrinkled or smooth, shagreened, not pustulose; striae usually effaced near bases of elytra, margin of last abdominal sternite not grooved; with fore tibia abruptly curved and expanded apically and all femora with tomentose line on inner faces. Total length 9–12 mm. Victoria, New South Wales, Queensland ..... *sydneyanus* (Blackburn)
— Base of pronotum straight or nearly so without transverse depression, inflected portions pustulose; elytral striae, except 7 and 8, complete to bases; margin of last abdominal sternite deeply grooved, ♂ with hind femur more or less distorted, femora without tomentose lines.....2

2(1) — Underside of prothorax glabrous, prothorax often quadrate in outline (Fig. 34); total length 6–10 mm. South Australia, Tasmania, Victoria, New South Wales and Queensland..... *colydioides* (Erichson)
— Underside of prothorax, especially prosternal process, with long setae; prothorax narrowing anteriorly (Figs 35, 36).....3

3(2) — Prosternum pustulose, upper surfaces coarsely punctate and shagreened, matt; total length 12–13 mm. Tasmania ..... *humilis* (Erichson)
— Prosternum punctate only; upper surfaces finely punctate, nitid; total length 8–11 mm. Northern New South Wales, Queensland..... *rectibasis* (Carter)

Bassianus sydneyanus (Blackburn), comb. nov.
(Figs 4, 6, 33)

Menephilus sydneyanus Blackburn 1893: 132; Carter 1914: 53; Carter 1926: 146.

Type

Near Sydney, N.S.W. BMNH. A female on a card bearing the designation 'T 4515 Syd.', with labels saying '*Menephilus sydneyanus* Blackb.' and 'Blackburn Coll. 1910-236', is designated lectotype.

Distribution

Eastern Victoria, New South Wales east of the Great Dividing Range, south-eastern Queensland, with a few individuals collected as far north as Kuranda.

Material examined

One hundred and ninety-two specimens. Victoria: Beaconsfield; Brighton; Cann River; 5 km N Cann River; Hurstbridge; Macedon; Mt Dom Dom [?] 2,500'; Narracan; North Melbourne; 19 miles W of Tallangatta nr Koetong; Tyers River; Warragul. New South Wales: Acacia Creek; Barrington Tops *via* Salisbury; Bateman's Bay; Bellingen; Blue Mountains; Brooklana, Sydney; Carrai Plateau *via*

Kempsey; Chichester State Forest, Lagoon, Pinch Park; Comboyne, 9 km W of Coonabarabran, 533 m; Coopernook Creek nr Brooklana; 13 km W of Coramba; Dingo Tops, 57 km NW Wingham; Dorrigo; Forest Reefs; Gibraltar Range N.P.; Gloucester River (Barrington Tops); 30 km S Glen Innes; Illawarra; 4–8 km SW Lake Cathie; Lowden For. Park, 30 km NE Captain's Flat; Minamurra Falls *via* Kiana; Monga; Mt Kosciusko; Mt Royal Range, 17 km E Moonany Flat; Mt Wilson; Myall Lakes, Booloombayt.; 4 miles N of Nelligen; Poverty Point, 20 km SE of Tenterfield; Styx R., Wattle Flat Camp; Swan Lake; Tenterfield; Upper Hunter; Werrikembi N.P., Cobcroft Camp; Wollomombi Falls. Queensland: Bald Mt area *via* Emu Vale; Barron River Falls; Binna Burra N.P.; Boldery Park, Cooyar; Bulburin S.F.; Bunya Mountains; 26 km W Goomburra; Joalah N.P., Tamborine Mt; Kroombit Tops, 65 km SW of Gladstone, 1 000–1 100m; Kuranda; 12 km N Kuranda; Lamington N.P., McPherson Range N.P.; Mt Spec; Mt Tamborine; National Park; 10 km NE of Queen Mary Falls; Springbrook; Stanthorpe; Undercliff. Under bark, rotten logs; fallen logs; open forest. All months of the year. AMSA, ANIC, EMUC, MVMA, QMBA, SAMA, UQBA.

One pupa and several larval exuviae reared from larvae collected in Gibraltar Range N.P., New South Wales 27.XII.1982.

Bassianus colydioides (Erichson), comb. nov.
(Figs 2, 7, 34)

Tenebrio colydioides Erichson 1842: 175.
Menephilus colydioides, Carter 1914: 52; Carter 1926 :146.
Menephilus parvulus Macleay 1872: 285; Carter 1914: 53; Carter 1926: 146 (syn).
Menephilus armstrongi Carter 1933: 171. New synonymy.

Types

Of *colydioides*: Van Diemen's Land. A series of four female cotypes in MNHB, of which the specimen bearing the handwritten label '*colydioides* Er. Terr. V Diem. Schayer' and the number 45953 is hereby designated lectotype; the others labelled 'Hist. Coll. Nr. 45943 Terra van Diem. Schayer' are paralectotypes. Of *parvulus*: Two specimens in AMSA on an unmarked card, labelled *Menephilus parvulus* Mcl. W. Gayndah in Macleay's hand, and bearing the number K34632. Both were apparently considered to be holotypes by McKeown (1948). It is therefore necessary to select one as lectotype and the one on the left, a male, is hereby designated. The one on the right, a female is designated allolectotype. Three other specimens from Gayndah in the Macleay collection in ANIC, evidently from the type series, are designated paralectotypes. Of *armstrongi*: Holotype ♀, Nandewar Range, New South Wales, 6.XI.32, J. Armstrong, ANIC.

Distribution

South Australia (the South East and Kangaroo Island), Tasmania, Victoria, New South Wales along and east of the Great Dividing Range, south-eastern Queensland as far as Bundaberg, and Heron Island.

Remarks

M. armstrongi was distinguished from *colydioides* by Carter on features of puncturation, proportion and colour, but the type is a normal female *colydioides*.

Material examined

One hundred and forty-two specimens. South Australia: Lucindale; Wilson R., Kangaroo Island. Tasmania: Devonport; George Town; Hobart; King Island; Lakes; Launceston; Lefroy; Long Bay; Mt Wellington; National Park; River Isis; St Patrick's River; Tyenna; Wilmot; Wynyard. Victoria: Brighton; Hastings; Lake Corangamite; Lorne; Macedon; Moe; Nelson; Warburton; Warnambool; Warragul; Werribee; Yarra Junction. New South Wales: Blue Mountains; Congo, 8 km SE by E of Moruya; Forest Reefs; 30 km S Glen Innes; Hanging Rock; Maitland; Mt Canobolis, 3 500–4 500'; Mt Wilson; Mullaly; Muswellbrook; Oberon; Sydney; 6 km NE of Tenterfield; Wahroonga; Worrigee nr Nowra. Queensland: Brisbane; Bundaberg; Cunningham's Gap; Dunwich; Eukey; Heron Island; Indooropilly; Mt Glorious; River Heads, 14 km SW of Urangan; Stanthorpe; Toowoomba; Yarraman S.F. Logs, dry sclerophyll. All months of the year. AMSA, ANIC, EMUC, MVMA, QMBA, SAMA, UQBA.

Bassianus humilis (Erichson) comb. nov.
(Figs 8, 35)

Tenebrio humilis Erichson 1842: 174.
Menephilus humilis, Carter 1914: 53, Carter 1926: 146.

Type

Van Diemen's Land. Four female cotypes in MNHB, of which the specimen bearing the handwritten labels '*humilis* Er.' and 'Terra van Diem. Schayer', and the number 45952, is hereby designated lectotype. The other three with recent labels 'Hist. Coll. Nr.45952 Terra van Diem. Schayer' are paralectotypes.

Distribution

Tasmania.

Material examined

Three specimens. Tasmania: Brighton; Lakes; River Isis. Nov. SAMA.

Bassianus rectibasis (Carter) comb. nov.
(Figs 9, 36)

Menephilus rectibasis Carter 1914: 53, 70; Carter 1926: 146.

Type

Dorrigo, Cox. Two males on a card in MVMA. The smaller left hand one has the letter 'T' written below it on the card and is here designated lectotype (T–4093). The other specimen (T–4094) is designated paralectotype.

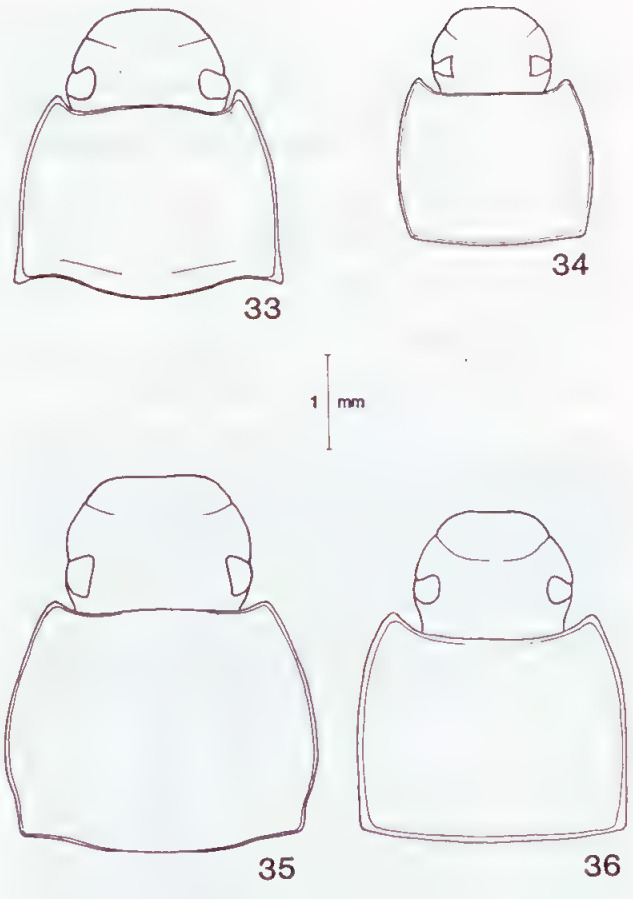
Distribution

North-eastern New South Wales and south-eastern Queensland, with an apparently separate population in the area of the Atherton Tableland.

Material examined

Eighty specimens. New South Wales: Alstonville, Lumley Park; Barrington Tops, Allyn R. Forest; Cascade; Dorrigo; Dorrigo N.P.; Grafton; Lismore; New England N.P.; Richmond River; Tooloom Scrub *via* Woodenbong; Tooloom. Queensland: Brisbane; Bunya Mountains; Cairns District; Cooloola N.P. nr Poona Lake; Herberton; Joalah N.P., Tamborine; Lamington N.P., Malanda; Lever's Plateau *via* Rathdowney; Mt Glorious; Mt Tamborine; National Park; Ravenshoe. Rainforest. Apr.-Feb., mainly Sep.-Dec. AMSA, ANIC, EMUC, MVMA, QMBA, SAMA, UQBA.

Two mature larvae and several exuviae laboratory-reared from adults collected in New South Wales, Barrington Tops, Allyn River Forest, 9.XI.1982.



FIGURES 33–36. Dorsal outlines of head and pronotum of *Bassianus*. 33, *B. sydneyanus*. 34, *B. colydioides*. 35, *B. humilis*. 36, *B. rectibasis*.

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PREPARING GRASS WITCHETTY GRUBS

L.A. HERCUS

HERCUS, L. A. 1989. Preparing grass witchetty grubs. *Rec. S. Aust. Mus.* 23(1): 51–57.

This paper presents information on cultural practices relating to food preservation and preparation of grass witchetty grubs among the Wangkangurru people of the Lake Eyre Basin of south-eastern central Australia.

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It has long been known that Aboriginal people, particularly in the Lake Eyre Basin, stored dry food. The foods most commonly dried were those which were highly seasonal. There was sometimes a surplus of fish when lakes and waterholes were drying out. Reuther has mentioned how the Diyari people of the lower Cooper processed this fish, drying it and reducing it to powder: there are several references to this in his vocabulary (e.g. Reuther 1981, IV: 3051, 3712). This procedure was also used among Arabana people on the western side of Lake Eyre: it even plays a part in myth. The Arabana Fish History relates how there were women at a birth-camp near Sunny Creek on Anna Creek Station. As was the custom, men threw over food for them to eat, and as fish was plentiful, they were given the most common type, bony bream, more and more of it. They could not eat it all and so they put it out in flat layers to dry. It turned into the slabs of rock at the famous *Palthirri Pithi*, the Anna Creek grinding stone quarry.

Some grubs were similarly dried and powdered. Reuther gives an account of how the Diyari Ancestor 'Darana' (Reuther 1981, X: 10) by means of magic incantations collected grass witchetty grubs, called *muluru* in Diyari, and then dried and powdered them. The whole matter of food storage has recently been studied by Kimber (1984: 18), and the present paper gives further background to his comments on dried grubs.

The term 'witchetty grub' refers to the larvae of a number of different species of insects. N.B. Tindale has worked extensively on these (1953, 1958). The distinctions made between grubs in Aboriginal languages usually refer to the habitat (Johnston 1943). Thus in the Wangkangurru language of the Simpson Desert the green caterpillars that appear in large numbers after rain and feed on the fresh grass are called *wadnhamarra* (Lower Southern Aranda *anhemare*). Root grubs (larvae of buprestid beetles and cossid moths) are called *pardi*, and this word is also used as a general term for all caterpillars. The grubs from box-trees have the special name *pitha-kapurru* (larvae of hepealid moths, Cleland 1966: 144). The very large green caterpillars that live in foliage are called *yatinjangu*. In the mythology too these different types of grubs all have their separate stories. There is a major myth and song cycle about a big 'Grub-war'. Different groups of ancestral grub men coming from the south, converge and have a battle on the grassy plains near New Crown in the extreme south of the Northern Territory.

FIGURE 1. Dora Parker with her youngest child, Fabian.

Everyone was happy to eat the grubs from roots and trees, but it seems that the grass grubs were dried and stored. This was not only a matter of food storage: these grubs were not considered edible except in powder form. The preparation of the grubs was an elaborate process which was still carried out by Wangkangurru and Yarluyandi people living according to a semi-traditional life-style in the 1930s at Pandie Pandie and at Andrewilla south of Birdsville.

Dora Parker *Alinda* (Fig. 1) could recall the Pandie days and Mick McLean *Irinjili*, her (classificatory) uncle (Fig. 2), had recollections of much earlier days in the Simpson Desert (Hercus 1986). Speaking in a mixture of Wangkangurru and English they discussed the preparation of grass witchetty grubs. Their conversation was recorded at Port Augusta in January 1967.[1]

FIGURE 2. Mick McLean and Jimmy Russell at Dalhousie, August 1967.

Text

1. M. They all go out in the green feed time, and they are singing then make'm breed up a bit more, them grass witchetty. They eat'm. I wouldn't.

2. D. I wouldn't. I used to see old people digging a hole.

3. M.	*mantarra,* wattle,	*wirilti,* sandhill wattle	get'm like broom		
4. D.	*mapa-lhuku* collect-HIST	*wirilti-ri* wattle-INS	*wirilti-ri* wattle-ERG	*nhangka-ma-lhuku,* alive-make-HIST,	*ilja-ma-lhuku.* active-make-HIST.
5. M.	*thukulu-nga* Hole-LOC	*kudni-lhiku.* put-HIST.			
6. D.	*maka-ra* Fir-CAUS	*ngarda-ngura,* burn-CONT,	*kanhangarda* there	*wadnhi-lhiku.* cook-HIST.	

Kids are not allowed to be there.

7.	*mapa-lhuku* build up-HIST	*maka thadlara* fire frightened	*thangka-ngura.* sit-CONT.

8. M. Not there, we not allowed there when they are cooking, old ladies, boys are not allowed to come in there.

9. D. They have their fire all ready. One,

nhanhanga	*nguru-ru*	*uka-nha*	*maka*	*thupu*	*mapa-rna,*
There	other-ERG	he-ACC	fire	smoke	collect-IMP

partjarna	*thupungka-la-yira.*
all	smoke-ALT-PUNC.

10. One make a fire and they all make it same time. All level.

11. D.

kanhangarda	*kudna*	*thanti-lhiku.*
There	guts	get out-HIST

They tear it open and pick the grass out of them,

kudna	*thanti-lhiku..*
guts	get out-HIST.

12. L. There is grass inside?

13. M. That green stuff.

14. D. From when they eat grass.

katharra-ma-rna,	*kudna*	*thanti-lhiku.*
Torn open-make-IMP	guts	get out-HIST.

15. M. Take the head off, chuck'm all hot then.

16. D.

thawi-lhiku	*kari-nha*	*katharra-ma-rna..*
Throw-HIST	they-ACC	torn up-make IMP

17. M.

thati-ma-lhuku,	*thingki-la-lhuku,*
dry-make-HIST,	dry off-ALT-HIST,

(in smoke) like from a motor-car (exhaust), but you are not allowed to see that,

18. Boys not allowed.

19. D. Girls not allowed to be there.

yaka-yaka-rna	*kari-ri.*
Chase away-IMP	they-ERG.

20. M.

kari-ri	*wadnhi-ngura*	*pardi*	one day.
They-ERG	cook-CONT	grub	

21. Might be a couple of days time, when he get dry,

kari -ri	*ngampa-lhuku*	*pirda-ru*
they-ERG	pound-HIST	beat-NAR.

22. L.

What about	*paya-paya?*
	little birds?

23. M. They got plenty to eat, they wouldn't come up..

24.

ngampa-ru	*thaka-lhuku*	*pirda-lhuku,*
nardoo stone-ERG	strike-HIST	beat-HIST

pulhpa-ma-rna	*thaka-lhuku.*
powder-make-IMP,	strike-HIST.

25. Some fellow fill'm up in a bag.

yakuta-nga	*thangka-ngura.*	*pirda-yi-ngura.*
Bag-LOC	stay-CONT.	Beat-ACT-CONT.

26. You are not allowed to see that too. Ha, Ha! They were very particular.

27. D. And when they eat that, they get that *paRu* then, *arkapa,* they paint their mouth[2] with that.

28.

paRu,	*arkapa-ra*	*untharna*	*marna-ki-thi*
yellow ochre	red ochre-CAUS,	pipeclay	mouth-EMPH

pithi-rna-ya -lhuku.
paint-SP-TR-HIST.

arkapa was the red one.

29. M. *untharna* we call'm. *untharna* and *miRaka.* There is no *warru* in it, only *yikurla.* We get'm off west, from Musgrave Ranges, Antikirinja people. We got a place too where you get'm *URara,* out from Granite Downs.[3]

30. L. When they put that *paRu* on, then they can eat it?

31. D. After. (Or else they would get) a sore throat . . .

32. M. They reckon it is good after it dries out, just the same as with fruit, you dry'm out and put'm through the machine, same way.

33.

pulhpa-ma-rna	*pirda-lhuku*	*ngurngku-ma-lhuku-ki-thi.*
Powder-make-IMP	beat-HIST	ash-make-HIST-EMPH.

34. D. I don't like it when they smash'm up and fine and smooth'em, I hate the smell. Ugh!

35. One day my old *kadnhini*[4] been tell me,

thika-rnawu!	*anthunha*	*mani-lhiku*	*wirinja-nga*	*pardi pulhpa!*
Return-IMPV!	Mine	get-PURP	nest-LOC	grub powder!

36. I went home and I got this bag and I smelt it,

pardi pulhpa.
Grub powder.

37.

kawa-lhuku	*mathapurda!*	*thawi thika-rna.*
vomit-HIST	old man!	Throw return-IMP.

38.

minha-ku	*untu*	*thawi-ra,*	*wadla-kunha-thu.?*[5]
What-DAT	you	throw-PUNC,	hungry-POS-EMPH?

39. I didn't answer the old lady, I was too busy vomiting.

Translation

1. M. They would all go out in the green feed time, it was then that they would sing to make them breed up more, those grass witchetty grubs. They used to eat them, I wouldn't.

2. D. I wouldn't. I used to see old people digging a hole.

3. M. (Pieces of) wattle and sandhill wattle, they would use them like a broom.

4. D. With this sandhill wattle they used to collect them together (those grass witchetty grubs), they would liven them up and make them move.

5. M. They pushed them into this small hollow.

6. D. They heated them up in a fire, they cooked them there. Children were not allowed to be there.

7. They built up a fire and sat there secretly.

8. M. We were not allowed to go there where they were cooking, the old ladies. Boys were not allowed to come near.

9. D. They would have the fire ready. One did this while another got the smoke to go into one place. They smoked (the grubs).

10. They (made a number of fires like that) all at the same time, all level.

11. Then they would take the guts out (of the grubs). They tore them open and picked the grass out of them. They got the guts out.

12. L. There is grass inside?

13. M. That green stuff.

14. D. From when they eat grass. They tore them open and got the guts out.

15. M. They took the head off, and tossed them down, all hot.

16. D. They threw them down after they had torn them open.

17. M. They dried them out, they got all the moisture out (in a stream of smoke) like from a motor-car (exhaust), but you were not allowed to see that.

18. Boys were not allowed.

19. D. Girls were not allowed to be there either. They chased them off.

20. M. They would cook all the grubs on one day.

21. And then in a couple of days time when they were quite dry, they would pound them and smash them up.

22. L. What about little birds?

23. M. They had plenty to eat, they wouldn't go near there.

24. They used to pound (the dry grubs) with a nardoo stone and beat them and smash them to powder.

25. Then some (old women) would put them into bags. They kept (the grubs) in bags after they had ground them to powder.

26. You were not allowed to see that either, ha ha! They were very particular.

27. D. And when they came to eat that, they got yellow ochre and red ochre and painted their mouth with it.

28. They got red ochre and yellow ochre and pipeclay. They painted their mouth.[2] The red ochre we call *arkapa.*

29. M. *untharna* is what we called the pipeclay, there was *untharna* and the red stuff. The (ordinary) white gypsum was not used, only the pipeclay which was also called *yikurla.* We got it from far away to the west, from the Musgrave Ranges, from Antikirinja people. We had a place too where you could get it from, *URara,* that is out from Granite Downs.[3]

30. L. After they had put that ochre on, then they could eat it?

31. D. Yes, after, Or else they would get a sore throat.

32. M. They reckon it is good after it has been dried out, just the same as with fruit, you can dry it out and put it through a (mincing) machine, in exactly the same way.

33. They pulped (the dry grubs), they turned them into a meal as fine as ash.

34. D. I didn't like it when they smashed up the grubs and made them into a powder, all fine and smooth. I hated the smell. Ugh!

35. One day my old maternal grandmother[4] said to me: 'Go back home and get my grub powder. I have got it in a 'nest' (a type of head-band for carrying things).'

36. I went home and got this bag and I smelt it. It was grub powder.

37. I tell you old man, I vomited! I threw it down as I was walking back to her.

38. (My grandmother said): 'Why do you throw it away? It's perfectly good food![5]

39. I didn't answer the old lady, I was too busy vomiting!

Conclusion

In their book, 'The World of the First Australians' in a discussion of hunting and gathering, R.M. & C.H. Berndt state (1964: 104): 'Typically there is a magic associated with hunting, but not as a rule with food-collecting'. The collection and preparation of grass witchetty grubs was one of those exceptions to the general rule. There was magic and secrecy connected with it. In the Diari tradition quoted by Reuther it was a male ancestor who collected and prepared the grubs. Among Wangkangurru and Yarluyandi people, as shown by Dora Parker and Mick McLean, this activity was entirely restricted to old women: this is in keeping with general traditions, as it is usually women who collected smaller items and who do the tedious job of grinding. The fact that grass witchetty grubs only appear during very restricted periods no doubt brought about the feeling that this was a special occasion. It is not surprising that the preparation of the grubs came to be marked by prohibitions.

In the Lake Eyre Basin there were very few sites that were secret/sacred and exclusively reserved for only men or only women at all times. Secrecy was not so much site-specific and in at least some cases it reflected an attempt by special groups of people to get away from ordinary camp life, to have some privacy and not to be disturbed. The ritual associated with the preparation of grass witchetty grubs illustrates this.

Endnotes

1. The text transcribed in this paper was recorded in January 1967 as field-tape 65. A copy has been deposited with the Australian Institute of Aboriginal Studies in Canberra. For ease of reference the text has been split into numbered sections. The divisions are on the whole in accordance with intervals in speech. In the paper a practical orthography has been used for Wangkangurru: Plosive consonants other than the retroflex plosive have been written as unvoiced, (*k, p, th, t*), but prestopped consonants have been written with voiced plosives as this corresponds most closely to the pronunciations, hence: *bm, dnh, dnj, dl, dlh.* Retroflexes have been written as *r* + consonants, i.e.: *rl* is retroflex *l; rn* is retroflex *n, rd* is retroflex *t.* Interdentals have been written as consonant + *j,* hence *nh, th, lh.* Palatals have been written as consonant + *j* hence *tj, nj, lj. 'ng'* has been used for velar nasals. The three r-sounds have been transcribed as follows: *r* = the alveolar flap; *rr* = the trilled r; *R* = retroflex r.

The following abbreviations for linguistic terms are used in the interlinear gloss:

ABL	Ablative case	IMP	Imperfective
ACC	Accusative case	IMPV	Imperative
ACT	Active stem-forming suffix	LOC	Locative case
CAUS	Causative case	NAR	Narrative past

CONT	Continuous participle	PAST	Past tense
EMPH	Emphatic clitic	POS	Possessive suffix
PURP	Purposive	PUNC	Punctiliar past
ERG	Ergative case	SP	Speed form, indicating action undertaken
HIST	Historical past	TR	Transitory aspect

2. Painting of the mouth connected with the eating of particular items is also known from another ritual practice: people involved in the ritual cannibalism connected with one type of Ngamani rain-making ceremony painted their mouth black. Mick McLean corroborated Reuther's comments on this and said he had heard of it from older people, particularly from the distinguished old Ngamani rain-maker *Dinta* 'Sandy' (for an account of an interview with *Dinta*, *see* Farwell 1950: 53).

3. The Granite Downs area long ago was Aranda. However, when Antikirinja Western Desert people reached the area, there is reputed to have been a 'war'. But, there was also gradual infiltration and ultimately there were no Aranda people left in the area. Mick McLean, through his Aranda grandmother, often identified himself with Aranda people. Naturally he still knew what the original boundaries were; this is why he said 'we had a place'. There was also a pipeclay mine to the east of Lake Eyre at Powana Hill in Ngamani country. Since there were not many sources of pipeclay, it was a much more precious source of paint than powdered gypsum.

4. Dora Parker's maternal grandmother was the last surviving full Yarluyandi, Judy Trew *Thantripilinha* ('small poisonous snake'), a woman famed for both her knowledge and courage (*see* Morton 1976: 17).

5. The very common Wangkangurra expression: 'It's good food for someone who is hungry' does not imply that the food-stuff in question is inferior. It means simply that something is a normal, acceptable item of food.

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ABORIGINAL FIELDWORK IN SOUTH AUSTRALIA IN THE 1940S AND IMPLICATIONS FOR THE PRESENT

R.M. BERNDT

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This paper is a slightly revised version of a paper delivered to the Anthropological Society of South Australia on 17 November 1988 in Adelaide. Based on the author's fieldwork in the 1940s in South Australia, it looks at Aboriginal people and their changing circumstances in four major locations: Ooldea on the west coast, the northern region of South Australia centred on Oodnadatta, the Narrinyeri in the south-east and Aborigines in Adelaide.

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It gives me great pleasure to speak at this meeting of the Anthropological Society of South Australia: it must be well over 40 years since I last did so. In those days the Society was a closely knit one, although only a couple of its members had been trained in Anthropology. Moreover, there was some tension between the University of Adelaide's Board for Anthropological Research and the Sydney Department, then under the direction of Professor A.P. Elkin: it was the issue of amateur *versus* professional.

In the late 1930s, I was appointed an honorary assistant in Ethnology at the South Australian Museum. This appointment represented the turning point of my career. Aborigines from many areas regularly visited the Museum, and it was possible for me to make friends with many of them. I was interested in living people, and less inclined to devote my attention solely to material objects. It was in this context that I first met Albert Karloan, who became my spiritual father and mentor. Through myself, Karloan wished to fulfil his primary concern of recording all he knew about the traditional life of the Narrinyeri, and the changes that had taken place over the years. I began working with him in 1939 at Murray Bridge. Other Aborigines also made claims on my time. Ted Vogelsang at the South Australian Museum, for instance, introduced me to Dieri speakers; and, through Karloan, I was able to work with Ngadjuri and other men. In a sense, the field was so wide I had difficulty in selecting cultural areas for concentration.

In that same year, I was invited to accompany a University of Adelaide Anthropological Expedition to Ooldea on the west coast of South Australia. This was an exciting and crucial event that firmed up my ideas of devoting my career to anthropological research. First, however, I needed professional training. With the encouragement of J.B. Cleland, T. Harvey Johnson and C.P. Mountford, I went to Sydney to arrange matters with Professor Elkin. The Department of Anthropology at the University of Sydney was then the only place in Australasia where Social Anthropology was taught to graduate level. It was there in Elkin's room, at the beginning of the 1940 academic year, that I met Catherine, who had come from New Zealand to study Anthropology. In the following year we were married in Adelaide and went to Ooldea.

In the early 1940s we returned to South Australia to attempt what I would now regard as virtually an impossible task — of getting to know the different socio-cultural traditional and near-traditional Aboriginal lifestyles, together with an assessment of the magnitude of changes that had been imposed on these people. Of necessity, we had to be selective, but we travelled quite widely throughout the state before deciding on which areas to concentrate. We settled on four main ones. We would have liked to look at these in the form of a gradation, or range — from outback to urban, from low-risk to high-risk alien contact; but that was not practicable. Ooldea was included because we had already obtained detailed research material there. We had a deep-seated commitment to the lower River Murray–Point McLeay areas, and we had not yet fulfilled our promise to Karloan to settle down with him, and at the same time to meet many of the Narrinyeri people. That took priority. It introduced us also to Narrinyeri 'outliers' within the city of Adelaide. That, in turn, helped us to meet people from Point Pierce, and the mid-north generally, as well as other far northern areas. Most of our work in Adelaide was carried out in the homes of our Narrinyeri and other friends, as well as at my father's place in Rose Park. But also I was able to spend long periods with transient visitors to Adelaide, as well as local people, in Light Square, Whitmore Square and, occasionally, Victoria Square. We also met at the South Australian

Museum or, where elderly men were concerned, at the Magill Old Folks' Home. In passing I should mention that, at Professor Elkin's insistence, we concentrated on the collection of detailed genealogies. This was particularly the case with the Narrinyeri, Point Pierce and mid-north people. Knowing the background of so many people had a considerable bearing on our research, and on acceptance by Aborigines on the basis of knowing and being friendly with a number of their relatives. We also intended to continue our research over several years. However, late in 1944 we were involved in a survey of Aboriginal labour on pastoral stations in the Northern Territory, a survey that was urgently required. Moreover, this was during the World War II period, and we were the only anthropologists working in the field at that time.

Port Augusta was also an important centre for local Aborigines, as well as those from the mid-north, and Kokata people who had originally occupied areas north of Eyre Peninsula, and Roxby Downs and who travelled along the transcontinental railway to Ooldea. Many of them visited Adelaide. The other area centred on Oodnadatta, with its own local setting, but with direct linkages to Ernabella and the Southern Aranda, as well as along the north-south railway.

Before embarking on the survey, we sent questionnaires to missionaries and Aboriginal Protectors (police); arranged through the Director of Education (Dr Charles Fenner) for essays to be written by school-children in all country and city areas; and spent a certain amount of time in the South Australian Archives to obtain something of the state's historical perspective. Moreover, we had access to early police records for all the main areas in which we worked.

The following is a brief summary of each of our main research areas. I restrict myself to two features: one, with reference to the Aboriginal socio-cultural heritage; the other, relating to the changes that had taken place, and the impact of these on contemporary Aboriginal living. I recognise, of course, that to make a 'jump' from the 1940s to the late 1980s is an indefensible procedure. Nevertheless, on a number of occasions I have held that, at any particular period of the life of an identified group of people, the 'writing is on the wall' for those who wish to read it. The sad fact is that many do not — even those who are directly involved.

Ooldea

Ooldea was a time-honoured meeting place for many Western Desert people, long before a mission station was projected into its perspective. In the early 1930s and 1940s, family groups from various parts of the so-called Desert were making their way to the fringe settlements — not just because of bad seasons, but out of curiosity. Traditional communication networks had been spreading stories of a different people with a multitude of possessions. Ooldea, established in 1933, was one of their objectives. When we were working there in 1941 (Fig. 1), that process was continuing. It was their first experience of Europeans: not only missionaries, but gangers and fettlers, as well as passengers on the transcontinental railway, including Army personnel. The mission attracted Kokata people from the east, and some Aborigines from Zanthus and Kalgoorlie.

At Ooldea, the main missionary's task was to Christianise and Europeanise the Aborigines, but he had no knowledge of the local language. So he concentrated on other associated activities. As new arrivals appeared on the horizon, he and his helpers rushed to 'clothe the naked savage'; he tried to disperse initiation camps; and he collected ritual boards, that were then sold in Adelaide. This caused considerable strife and resentment, but did not detract, then, from the continuation of ritual life. On the other hand, people's introduction to a new diet did have considerable ramifications, and not solely in the sphere of health. Rations were distributed, especially to children and adults who attended church services. In 1941 the local people relied heavily on introduced food in contrast to bush foods. Gathering of indigenous food resources was severely diminished. Nevertheless, people talked incessantly about every aspect of it. Both Catherine and I were told literally hundreds of stories and firsthand accounts regarding such activities. They were useful in learning the Andingari and Yangandjara dialects, but they did not reflect the reality of what was then the present scene — although they were intended to do so. To supplement what was available at the mission, people began begging for food or for money from the train passengers or selling tourist items. In such circumstances, their traditional socio-economic system was not only undermined but crumbling. The dice were already loaded, and almost total dependence was not far off.

The missionaries had only mixed success in tackling the belief system of the adults, so they concentrated on the children. Almost everything taught within the rather primitive school was of non-Aboriginal derivation. Children were often free to wander about (Fig. 2), around the settlement, and their interests in this other kind of living were gradually enveloping them. That, in turn, widened the gap between themselves and their parents and adult relatives. Increasingly, knowledge or information that should have been passed on normally to the youth of the community was being limited, or in many cases withheld.

FIGURE 1. One of R. Berndt's 'working camps' at Ooldea, western South Australia, 1941. (Photo R. Berndt WU/P18542.)

FIGURE 2. School children digging a soak at Ooldea U.A.M. settlement. (Photo courtesy H. Green, 1941.)

Adults were outspoken regarding their own position. Most of them emphasised that they were not tied to the mission, nor were their children; that they could return to their home territories without effort on their part. But such was not really the case. Moreoever, the South Australian Aborigines' Protection Board decided in 1942 to move the Ooldea people. We opposed this on several occasions, to no avail. Additionally, a little later Maralinga was being established, and that restricted Aboriginal movement throughout a good deal of the Western Desert. If an enlightened Aboriginal policy had been in operation, with trained anthropological staff, it could have been possible to have stemmed the steady drift of the Ooldea people toward virtually an anomic situation, and to have reconstructed a viable community. Eventually, they found themselves at Yalata. The story, as most of you will know, does not end there: more recently, some of them have returned to an area within the vicinity of Ooldea.

Northern South Australia

The northern area straddled, socio-culturally, parts of south and central Australia, with Oodnadatta as the focal township. Its heterogeneous population consisted of a residue of local people drawn from areas around Marree north to the Finke, supplemented by Southern Aranda and Western Desert people.

Three groups or categories of Aborigines were distinguished, hierarchically positioned below the Europeans. The first, speaking only English, lived in reasonably pleasant houses and were usually employed on a more or less regular basis — but were reluctantly accepted by the European townsfolk (Fig. 3). The second consisted mainly of women married to or living with European men. Their style of living did not differ markedly from members of the first group, but their houses did. These women spoke Aboriginal dialects, but did not normally attend camp ceremonies. Their interaction with other groups was minimal.

On the open plain, on the outskirts of Oodnadatta, were Western Desert and Southern Aranda people arranged spatially as two overlapping camps: they were supplemented by Aborigines coming in from Ernabella to the north-west and beyond, even though Ernabella was originally established as a buffer between so-called 'bush' people and those working on pastoral stations and in the town (Fig. 4). Members of this third group were primarily regarded as being traditionally-oriented and maintained their ritual and other responsibilities. However, among them were station Aborigines spending rest-periods there. Windbreaks and huts built of old iron, bagging etc. were the normal shelters, with no amenities except for the provision of water. Occasionally, they were employed on menial tasks in the township and on the surrounding stations (Fig. 5). The people were dependent on introduced commodities, because food-collecting and hunting had become difficult on account of the cattle and sheep pollution of the water-holes and the general condition of the countryside as a result of cattle-running.

These three groups were relatively isolated from one another, and the position of each within Oodnadatta's compartmentalised society was conditional on their measure of Aboriginality. The less one had of that, the more grudgingly acceptable one was to the dominant European group.

Beyond Ernabella and within the central ranges, many 'bush' Aborigines had had little or no alien contact. Certainly, many of them would have visited Ernabella, but many had not. However, the long arm of the 'civilising' process stretched out in the shape of the Oodnadatta police, who had jurisdiction over this part of the country. In the 1930s and early 1940s, cattle and sheep spearing was rife, with damage to station property, and occasional murders and theft. There were no examples of liquor-related offences at this time. Mostly, Aborigines were reacting against the intrusion of Europeans into their country, the depletion of food resources, bad treatment on the stations, and interference with women. The police expeditions traversed wide areas of country in search of witnesses and culprits. 'Prisoners' were usually available, whether or not they were the primary instigators in a particular incident. They were brought back to Oodnadatta, sometimes with neck chains. If the charges were serious, they would be sent down to Port Augusta; otherwise they were tried locally and if found wanting were retained at the police station for gardening or other odd jobs. Incidentally, people in this area had experienced the severity of punitive measures that had been wound down by the 1940s; but, as would be expected, these nurtured bitterness among Aborigines and fear of the police who were simultaneously 'Protectors of Aborigines'. I should mention that we were able to record in writing most of the early and recent (up to 1944) cases that were entered in the police books held at Oodnadatta and Port Augusta. However, we heard later that most of the more detailed documents had been destroyed in a fire at Port Augusta. We had tried to persuade the police there to have these lodged in the South Australian Archives.

The third group of Aborigines I mentioned, who lived on the outskirts of Oodnadatta, was originally recruited from such 'bush' people. Many did not return to the central ranges — not at that time. They brought with them their traditional way of living which, while it temporarily sustained ritual activity

FIGURE 3. Race meeting at Oodnadatta, 1944. (Photo R. Berndt WU/P18543.)

FIGURE 4. Ernabella Presbyterian Mission station, 1944. (Photo R. Berndt WU/P18543.)

into the 1940s and beyond, was doomed to be drastically changed. Aborigines who were part of the other two groups had no use for it.

The Narrinyeri

In contrast to the other two areas of our survey, we have the Narrinyeri, who originally occupied the Encounter Bay, Lakes, Coorong and lower River Murray areas: people who had experienced alien contact prior to the foundation of this state. I call them Narrinyeri, although traditionally they were referred to as the Kukabrag, and within that wider group several different dialects were spoken. Moreover, on the eastern shore of St Vincent's Gulf they interacted with the Adelaide Aborigines.

Initially, sealers from their stronghold on Kangaroo Island sought women from the mainland. The local people were powerless to act against them. Their hatred of these intruders engendered attitudes that had not diminished in the 1940s. They were also exposed to two primary 'waves' of smallpox prior to European settlement in their area, that decimated a large number of the people — to such an extent that they were unable to utilise adequately their own land and its natural resources as they had done before. Nor were they in a position to defend their homeland and themselves from external incursions. Isolated incidents of resistance did occur, but nothing on a wide scale. Some form of independence was possible away from European settlements: traditional life continued there, albeit in a modified way.

Point McLeay mission station was established in 1859 by George Taplin in the heartland of the Narrinyeri. In the face of hostile or disinterested outsiders, it was the only place within the whole area that constituted a reasonably safe refuge. In general terms, the presence of the mission provided a breathing space for the Aborigines; without it, disintegration of their traditional lifestyle would have been more rapid, and their ultimate chance for re-adaptation slender. It ensured their survival as an identifiable people, with long-term territorial associations. I will not go into the history of the mission, except to say that, on the negative side, Taplin's influence was directly and indirectly responsible for the breakdown in many features of traditional life. The elders — both men and women in authority, since equality of the sexes was a marked characteristic of Narrinyeri society — continued to resist blatant interference in their own affairs. However, they did not turn their backs on what Europeans had to offer, especially in relation to material goods and liquor.

The younger members of the community were under the direct influence of the mission, and a number rebelled against their elders; but many did not. It was possible in 1882, against the expressed wishes of Taplin, for the last widely-attended initiation ritual sequences to be held. This was probably the last public attempt on the part of the knowledgeable leaders to impart traditional information to selected members of the younger generation. Albert Karloan was among the **narambi** novices.

The formal Narrinyeri **yanarumi**, a unique Aboriginal court in which both men and women participated, was winding down by 1860, when its punitive functions gave way to the European mounted police. It struggled on, however, attempting to resolve matters of an internal nature, until the death of King Peter Pulami in 1888. He would have been succeeded by his son, John Lelindjeri — but Lelindjeri had come increasingly under the influence of the mission.

The break with traditional culture became a reality with the passing of 'the old people' — the parents of, for example, Karloan, notably his father Taramindjeri; or the mother of Pinkie Mack (Fig. 6), Louisa Karpeny; and many others. The years between 1888 and the mid-1920s saw most of them gone. Of course, it was not a *complete* 'cut-off', since fragmentary knowledge survived. But in terms of living according to Narrinyeri conventions, it was. Overwhelmingly, that background was being crowded out by European elements; and the impact of what came across as mainstream Australian society and culture had priority in contemporary living (Fig. 7). There were, however, special persons (men and women) who were concerned about the retention of their historic heritage: their survival continued only into the mid-1940s, or a few years beyond.

There are two crucial features that sustained Narrinyeri identity. One, even though Narrinyeri men and women contracted unions with non-Narrinyeri people and non-Aborigines from different areas (and that in itself was no recent occurrence), the Narrinyeri 'family' circle persisted, with the retention of the old personal and family names derived from their traditional past. Two, while people had been moving out of their home territories over a number of years, establishing branches in the city of Adelaide and elsewhere, they did not lose touch with their own kin or with their country of origin. While this does not mean detailed knowledge of dialectal and clan territories, along with the relevance of mythic sites and so forth, it does involve knowing where they belong, and something of the available resources within their land. This is, in fact, a remarkable achievement on their part, in the face of heavy pressures toward absolute assimilation into the wider system.

Adelaide

The situation in Adelaide in the early 1940s was complex. Most Aborigines lived in the 'West End',

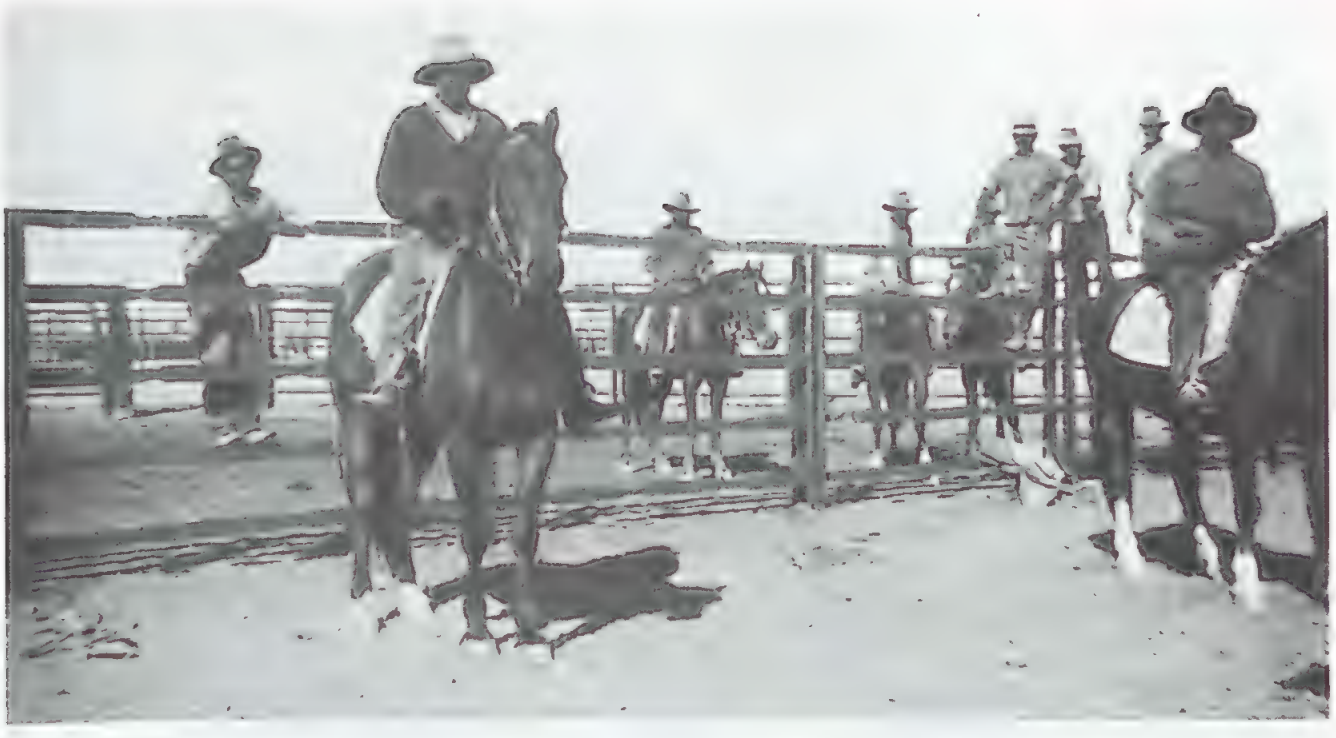

FIGURE 5. Aboriginal stockmen at Macumba, northern South Australia, 1944. (Photo R. Berndt WU/P18535.)

FIGURE 6. Mrs Pinkie Mack, Piltindjeri clan, Yaraldi dialect, with two of her grandchildren. A daughter of Louisa Karpeny, she lived at Brinkley on the lake entrance to the River Murray in 1943. She was a close friend of R. & C. Berndt. (Photo R. Berndt WU/P18537.)

which was not the most salubrious of the city's areas. Also, its mixed population included other non-Europeans as well as Aborigines. The permanently resident Aborigines interacted with Aboriginal transients drawn from the mid-north and elsewhere. There was less negative discrimination and prejudice between people in all these 'groups' than between, for example, Aborigines and Europeans living outside the precincts of the inner city, who were mostly categorised as being economically better off. Aborigines who did live outside the city in the suburbs, generally severed connections with their kin living in the 'West End'. Many of them were virtually lost within the wider society, to emerge later as identified Aborigines when recognition of Aboriginality became politically acceptable.

Apart from these people, internal relations between Aborigines themselves were on the whole amicable, although arguments tended to flare when alcohol came into the picture. During this period Aborigines were forbidden to obtain liquor — although there were many avenues of access to it. Men who had been (or who were still) in the Army were strongly critical of this prohibition. This was a profitable field for police action: raids were constantly being made. Non-Aborigines talking to Aborigines were also a target — as I was on several occasions when drinking lemonade with my friends. We were forced to open any bottle we had, to enable plain-clothes officers to smell and even taste what was in it. Most Aborigines lived under the shadow

FIGURE 7. Seasonal grape-picking at McLaren Vale, South Australia, in 1944. The people participating were of Narrinyeri descent. (Photo R. Berndt WU/P18536.)

FIGURE 8. Barney Waria (or Warrior) and Jim Mooney, both men of Ngadjuri descent, 1943. They were close friends of R. Berndt and, when they were in Adelaide, spent much time with him. (Photo R. Berndt WU/P18534.)

of 'offences' of one kind or another, most of a minor nature, and resented doing so. Women, particularly, read the local newspapers regularly to search for references to relatives and friends who had been unfortunate enough to appear before a court of law. External relations, on the other hand, were focused primarily on the Aborigines' Protection Board, that was used as a butt for all kinds of controversial matters. Constant visits were made to complain about the indifferent social conditions and/or to extract government aid. The Chief Protector was, with good reason, disliked by all Aborigines and by ourselves. Violent quarrels often resulted from trivial affairs that *could* have been resolved by the Board without too much difficulty.

While many Aborigines aligned themselves with Europeans and with the government, in general terms, many — the majority — did not. Bitterness and discontent were most marked because of the rebuffs they experienced as being 'coloured' people. Those Aborigines who did sever their ties with relatives in order to 'disappear' within the wider community, hoped to avoid what was then regarded by so many Europeans and Aborigines alike as the stigma of being 'coloured'. On the other hand, many resented the fact that their own traditions and culture had been more or less deliberately destroyed.

Two letters of interest in this connection appeared in the Adelaide *Advertiser*, the first on 28 January 1944 and the second on 1 February 1944. George Rankine, a Narrinyeri descendant, made a plea to the general public to give Aborigines 'some justice, sympathy and understanding'. He mentioned the destruction of Aboriginal culture, emphasising that nothing could compensate for its loss. Material benefits were all very well, he said 'but we need something which Australian–European society, with all its unrest, its inequalities and its intolerance, has not been able to provide'. 'We are hoping', he continued, 'that the future may bring something better'. Barney Warrior (Fig. 8) supported Rankine's letter, adding that 'people are too ready to judge without understanding, and most like to think that anyone with a dark skin cannot possibly be as good as they are themselves'. Continuing, he said, 'Those of us in the city are living the same way as white people, yet because of our colour and descent (in which there is after all a lot of white blood) we are not socially accepted. They talk about equal opportunities and treatment, and yet we ourselves know very well the things that are said about us, even by people who profess to feel kindly toward us'.

In a nutshell, these two letters provided a summary of Aboriginal feelings in Adelaide in the 1940s: but they also strike a contemporary chord. They were sufficient to stimulate us to write 'From Black to White in South Australia', which we originally entitled 'This way to freedom!' — although the publisher preferred the other title. It was 'freedom' that they wanted, to throw off the shackles of obsolete and ethnocentric rules and regulations. Aborigines at that time were talking about the abolition of exemption certificates and the need to recognise them as Australian citizens — weren't they 'the only *real* Australians'? Moreover, they wanted to manage their own reserves as independent settlements. To achieve this they set up small committees, many of which were doomed to failure since some Aborigines feared the repercussions of the Aborigines' Protection Board, and the power to withhold benefits or do harm to individuals. (The two letters I mentioned above engendered some ill-feeling among members of the Board.) Suggestions were also made by Aborigines that the Board should establish advisory committees — or, at least, appoint an Aboriginal representative. But there was no response. Approaches were made to the government to scrap the old *Aboriginal Act* — again, without any positive result.

Interaction with Aborigines of differing backgrounds and experiences visiting Adelaide from as far afield as Victoria and New South Wales, including some who had been attached to the Army, produced lively discussions that were based on attitudes and views which had not been generally heard before, or not so explicitly, by the majority of local Aborigines. The war had irrevocably altered conditions in the city, but not to any extent in country areas. The catalysts were those persons who had travelled and mixed widely with non-Aborigines. What they had to say was not far beneath the surface of the thinking of local people: they simply provided the opportunity for them to express their views. Within this context, the issue of land was raised. 'The richest land was taken away from us and no compensation was offered': that was often repeated. Economic security was the keynote, but many people recognised that without adequate education that aim could not be achieved. 'If we get money, we'll be all right!' was noted by several men. 'The thing to do is to be cunning like a white man and beat him at his own game! Aborigines had to stand up for themselves, otherwise government policy would not change!' Many Europeans regarded such views as revolutionary, promulgated by 'rabble-rousers'. But that was far from the truth of the matter. The climate of Aboriginal affairs was about to change, just as drastic changes were taking place in post-war Australian society in general.

Finally, it would seem clear that in the early 1940s, social conditions for Aborigines generally were far from satisfactory. In the north of the state and at Ooldea, the only means of rescuing traditional ways of living was to remain away from European settlements. That, however, was virtually impossible. Being faced with an enforced adaptation to a way of life they knew little or nothing about, confused the issues. Guidelines were not available. It was a matter of doing what they could, on their own initiative, as a matter of survival: the implications of such actions were unclear or unknown to them. Government intervention was negligible. Any positive policies that had been formulated were not enacted until well after the cessation of the war: and their implementation was a long-drawn-out business.

The long history of Narrinyeri contact with non-Aborigines placed them in a special position *vis-à-vis* adaptation to changing ways. But that did not save them from losing their living traditional culture and social imperatives. In a different respect, they were able to retain their unique identity as a people with recognised rights and obligations. That was possible through their high degree of acceptance of Australian–European living patterns and values.

Adelaide provided opportunities for a diversity of opinion and action, that had the potential for achieving their expectations of fairer treatment and eventual equality with other members of the wider community, without loss of identity.

There are two points I should mention here. One, Aborigines all over the country, whether or not they are traditionally oriented, are becoming increasingly committed to an Australian–European type of lifestyle and belief system, in varying degrees. Two, a growing awareness of the uniqueness of their own heritage is being counter-balanced by the construction of an overall, generalised, Aboriginal heritage, that could override the survival prospects of particular regional heritages relevant to many different Australian Aboriginal cultures. This is a crucial point — but it is one about which Aborigines themselves must make up their minds.

FURTHER EVIDENCE OF THE CHARADRIID AFFINITIES OF *PELTOHYAS AUSTRALIS* (AVES: CHARADRIIDAE)

The Australian dotterel *Peltohyas australis* (Gould, 1841) was originally placed in the plover genus *Eudromias*. Sharpe (1896: 307) erected a monotypic genus *Peltohyas* and subfamily for it, but kept it in the Charadriidae. Mathews (1913–14) suggested that it was a courser (Glareolidae) and Lowe (1931) supported this view with anatomical evidence. This taxonomic shift was accepted by Peters (1934). Jehl (1968) found that the *Peltohyas* chick was similar to those of *Cursorius* and *Rhinoptilus africanus* in colour, pattern and feather structure. Lowe's arguments were, however, refuted in the thorough anatomical studies by Bock (1964), Yudin (1965, 1978), Burton (1974) and Strauch (1978), who all concluded that *Peltohyas* has the anatomy of a typical plover. Evidence from behaviour (Maclean 1973, 1976) and ectoparasites (Emerson & Price 1986) point in the same direction. However, no one has reconsidered the arguments of Jehl, and no one has discussed where this peculiar desert bird fits into the phylogeny of plovers.

We examined the poorly-made specimen of a downy chick on which Jehl based his view (Australian Museum reg. no. 610162), and have also studied two new and better-preserved chicks (South Australian Museum reg. nos B 37686 and 38525) and colour slides provided by Mr J. Hobbs and slides in the Photographic Index of Australian Birds, National Library, Canberra. On the basis of comparison with downy young of practically all other shorebirds of the World, and some anatomical specimens, we hope to reach a more precise conclusion concerning the systematic position of the Australian dotterel. The anatomical terminology follows Baumel (1979).

Ultrastructure of the Natal Down

Down from the dorsal tract of three *Peltohyas* chicks was examined by Scanning Electron Microscope (SEM), and was compared with corresponding down of 72 other species of shorebirds. Figure 1 shows SEM micrographs of down of *Pluvialis, Peltohyas* and *Cursorius*. The *Peltohyas* down closely resembles that of typical charadriids, with moderately dense, basally twisted radii that alternately turn ventrally and dorsally to the ramus, and possess marked nodes near the cell borders of the pennulum, which is relatively long (apomorphy of the Charadriidae). There is no dextral twisting of the rami, as seen in many Scolopacidae.

The down of *Cursorius* and *Rhinoptilus* (Glareolidae) is very different, resembling down of sandgrouse, Pteroclididae (Fjeldså 1976). In these groups, the flattening of the basal portion of the ramus continues to the proximal part of the pennulum; the barbules are therefore stiff and not twisted as in normal avian down. The barbules are also packed exceptionally closely, so that each ramus with its radii forms a distinct single-plane structure resembling a minute contour feather. The ventral down is, in some of the coursers, very thick with extremely long terminal filaments.

Many plovers of hot and arid climates have short down with a somewhat scale-like appearance, which apparently misled Jehl (1968). The SEM study shows that the natal down of *Peltohyas* is not specialised in the way shown in coursers.

Colour Pattern of the Downy Plumage

The *Peltohyas* chick is light pinkish-buff to light fawn with some whitish areas on the hindcrown, laterally on the dorsal tract, throat and belly, and with numerous black markings, the largest of which have tawny-buff centres. The general coloration and expression of a pattern resembles that of certain coursers, especially *Cursorius cursor*, and differs from that of most plovers. Because of the perfect crypsis of these chicks, however, we judge the colour hues and presence of a pattern as such to be unreliable as clues of systematic affinity. The precise organisation of the pattern is less likely to be adaptive, and may instead indicate the genealogical affinity (Fjeldså in press).

FIGURE 1. Drawings made from SEM photos of the middle portion of a radius of dorsal natal down of (from left to right) *Pluvialis apricaria, Peltohyas australis* and *Cursorius coromandelicus*. Note that the *Pluvialis* down has been partly turned, to show how alternating pairs of cilia turn dorsally and ventrally.

Although the pattern of the *Peltohyas* chick (Figs 2 and 3) is ill-defined and somewhat variable amongst individuals, it generally resembles that of plovers, with no indications of the two big back patches of *Rhinoptilus cinctus* or the peculiar lattice pattern of the chicks of at least four other courser species. Plover-like traits comprise the kind of spotting, the transverse bands of the hindcrown and the organisation of markings along the dorsal tract. The whitish crescent on the posterior crown is found only in a small part of the Charadriidae (and in *Pluvianus aegyptius*). The crescent is particularly conspicuous, contrasting with a dark nape, in *Charadrius melanops* and *tricollaris* (Fjeldså in press, Fig. 1), *Hoploxypterus cayanus* and *Pluvianus*; the pattern being less clearly outlined in *Peltohyas, C. modestus, Erythrogonys cinctus* and probably in *Phegornis mitchellii* and *Oreopholus ruficollis*; and very weak in *C. novaeseelandiae* and *Anarhynchus frontalis.* The typical sand- and ringed plovers of Bock (1964) have instead a white nuchal collar situated below the occiput, while most *Pluvialis* forms and the desert plovers *Charadrius morinellus, asiaticus, veredus, leschenaultii* and *montanus,* the apparently related *'Pluviorhynchus' obscurus,* as well as the lapwing *Chettusia gregaria,* combine hind-crown crescent and nuchal collar.

The finer details of the pattern of the *Peltohyas* chick are hard to recognise in other species, but indications are found in several of the above-mentioned species. The clover-like mark on the crown seems unique, but is possibly indicated in *E. cinctus.* Such differences as the pebbled appearance of *C. melanops* (reduced marks on the dorsum, reinforced black side-line and strong countershading), a more disrupted pattern of *E. cinctus,* and the less regular speckling in other species, are likely to represent modifications conditioned by different habitats.

Some Features of the Adult Plumage

Peltohyas closely resembles the courser *Rhinoptilus cinctus* in its general 'desert colours', but is more *Charadrius*-like in pattern. The unique V-shaped breast-band could correspond to the median tapering of the breast-band that is special to *C. melanops. Peltohyas* agrees with some of the plovers that it resembles in natal characters, and with coursers, stone-curlews, oystercatchers, stilts and some other groups in having pale underdown and a very short lateral apterium of the neck. These are probably primitive character states. Small species such as *C. melanops, tricollaris,* and *novaeseelandiae* and *Erythrogonys cinctus* agree with other plovers (*viz.* the majority of species) in these respects. Because these characters may be involved in heat regulation, parallelisms are likely to occur.

Evidence from Skeletal Characters

In order to examine whether the affinities suggested by plumage characters are compatible with other character sets, we examined skeletons of a number of shorebirds, and used published skeletal data. The review of 70 skeletal characters by Strauch (1978) showed very little variation within the Charadriidae. Owing to some apparent reversibility, and to doubts about the correctness of certain distinctions between primitive and derived character states, very few characters provide hints about the relationship of *Peltohyas* to other Charadriidae.

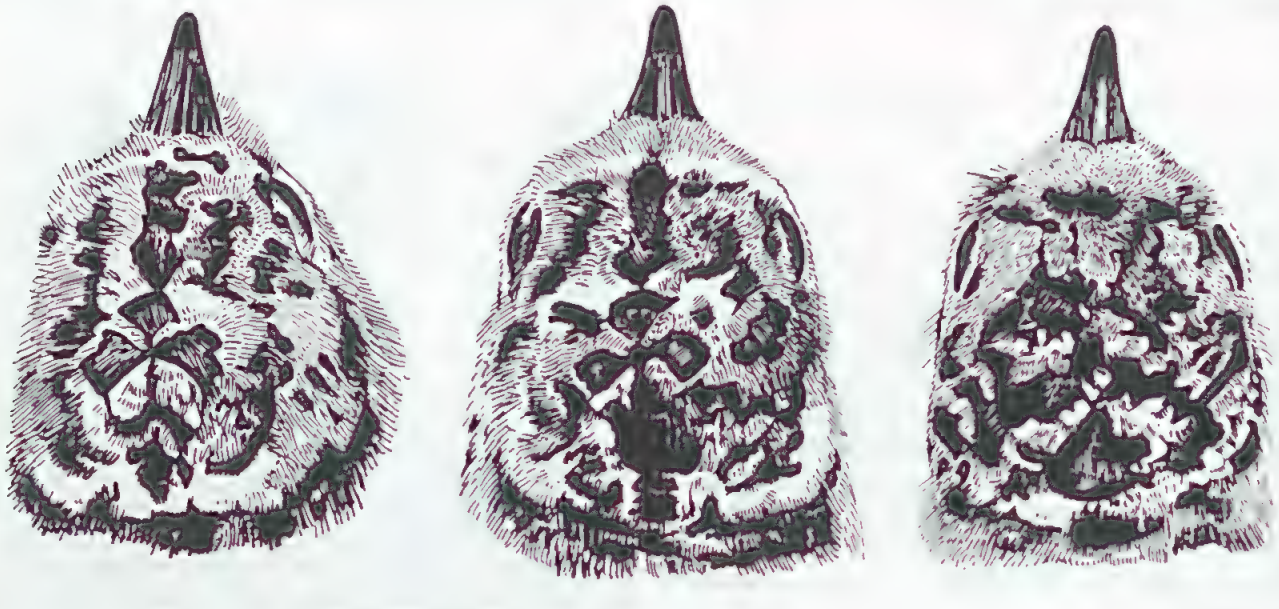

FIGURE 2. Heads of three *Peltohyas* chicks.

FIGURE 3. Dorsal colour patterns of newly-hatched chicks of A. *Charadrius morinellus,* B. *C. modestus,* C. *C. cinctus,* D. *Peltohyas australis,* E. *Rhinoptilus africanus* and F. *R. cinctus.*

Lack of supraoccipital foramina in *Peltohyas* is shared by stone-curlews, sheathbills, seedsnipes, certain lapwings, all gulls and curlews. This may be a primitive state, but may also be conditioned by a rather solid construction of the skull. *Peltohyas* shares a somewhat restricted attachment of Musculus rectus capiti with a number of small plovers, including *Erythogonys cinctus, Charadrius melanops* and *novaeseelandiae* and *Anarhynchus frontalis.* It shares a long suprameatic process (derived state) with several of the plovers with which it shares natal characters. A peculiar broad triangular shape of the quadrate bone of *Peltohyas* (Bock 1964, Fig. 1) we found to be matched only in *Charadrius melanops,* but it is approached in *C. tricollaris* and *Hoploxypterus cayanus.* The general shape of the mandibles of *Peltohyas* is *Charadrius*-like (Bock 1964), and particularly resembles those of *C. melanops* and *tricollaris.*

The systematic unity of the species which *Peltohyas* resembles in natal characters is supported by a lack of a certain maxillopalatine strut in *Charadrius tricollaris, morinellus, dubius* and *vociferus, H. cayanus, Phegornis mitchellii, Oreopholus ruficollis* and several *Vanellus* species and by an almost perfect agreement in Strauch's skeletal characters between the aberrant *Erythrogonys cinctus* and *C. melanops.* In the absence of our own anatomical material of *E. cinctus* we have been unable to make further comparisons. Burton (1974) and Strauch (*op. cit.*) present evidence for transferring *H. cayanus* from the lapwings to near *Charadrius.*

Conclusion

Our study fails to corroborate Jehl's argument that *Peltohyas* has a courser-like natal plumage. We find it plover-like in all respects, but fail to find indications of close affinities with the large species groups of desert-, sand- and ringed plovers, or with lapwings. These can be defined by their own apomorphies, and may represent rather recent radiations. *Peltohyas* shares two unique character states with *C. melanops* (V-shaped pectoral band and triangular quadrate bone). Yet, we hesitate to

suggest that these are sister taxa within the Charadriidae, for all those species with which *Peltohyas* shares some peculiarities are rather aberrant members of the family, and do not form a closely knit group. Some are traditionally placed in monotypic genera, and of those previously lumped in *Charadrius, cinctus* has now been separated in *Erythrogonys* (Condon 1975), *melanops* in *Elseyornis* (Schodde 1982), *novaeseelandiae* in *Thinornis* (OSNZ 1970). The distribution of these aberrant forms covers Australia, New Zealand, South Africa and South America i.e. the Gondwanaland continents. It seems possible, then, that *Peltohyas* belongs in a paraphyletic group of species representing an early radiation of *Charadrius*-like birds.

Our data support the conclusion of Phillips (1980), based on behavioural data, that *Charadrius bicinctus, C. obscurus* and *C. alexandrinus* belong to the large desert- and sand-plover groups of *Charadrius*. However, *Anarhynchus frontalis* could, in our opinion, belong in the above-mentioned ancient assemblage of aberrant southern plovers.

Acknowledgments

We thank L.P. Pedler, J. Reid and K. Casperson for collecting the two downy chicks of *Peltohyas australis* now in the South Australian Museum, and Mr Shane Parker for providing these specimens as a loan, and for commenting on the manuscript. We also thank the curators of birds of the following institutions for their courtesy in connection with museum visits or loans of specimens: American Museum of Natural History (New York), Academy of Natural Sciences (Philadelphia), Australian Museum (Sydney), British Museum (Natural History) (Tring), Carnegie Museum (Pittsburgh), CSIRO Australian National Wildlife Collection (Canberra), Denver Museum (Denver, Colorado), Field Museum (Chicago), Louisiana State University Zoological Museum (Baton Rouge), Musée d'Histoire Naturelle (Paris), Museo de Historia Natural 'Javier Prado' (Lima), Museo de Historia Natural 'Bernadino Ricadavia' (Buenos Aires), Museo de Historia Natural (Santiago de Chile), Royal Ontario Museum (Toronto), South Australian Museum (Adelaide), Swedish Museum of Natural History (Stockholm), and the Zoological Museums of Moscow and Oslo. Slides of wader chicks were kindly supplied by P. Disher, N. Dreyer, J. Hobbs, A.C. Kemp, G.L. Maclean, G. Moon and E. Thomas.

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SUPPLEMENTARY DESCRIPTION OF *HETERODISPUS LONGISETOSUS* (WOMERSLEY, 1955) (ACARI: TARSONEMINA) A SCUTACARID SPECIES FROM MUTTON BIRD NESTS IN SOUTHERN AUSTRALIA

Examination of the type series of the scutacarid mite *Heterodispus longisetosus* (Womersley, 1955), showed that important morphological details were neglected in the original description. It is thus appropriate to publish a supplementary description of the well-preserved material. I should like to express my thanks to Dr David C. Lee, South Australian Museum, for putting the type series at my disposal.

Material examined: ♀-Holotype and 39 ♀-paratypes. In all there are 10 slides: slide no. N1987155: holotype-♀ (marked) as well as further 4♀♀; slide no. N1987156: 2♀♀; slide no. N1987157: 5♀♀; slide no. N1987158: 4♀♀; slide no. N1987159: 4♀♀; slide no. N1987160: 5♀♀; slide no. N1987161: 4♀♀; slide no. N1987162: 4♀♀; slide no. N1987163: 3♀♀; slide no. N1987164: 4♀♀.

Heterodispus longisetosus (Womersley, 1955)

Variatipes longisetosus Womersley, 1955: 429, Fig. 10A-B
Heterodispus longisetosus (Womersley, 1955): Mahunka 1965: 363, 381, Table 4, Fig. 13, 14; Mahunka 1967: 1299; Mahunka 1977: 96.

Supplementary description

Body size and integument; Owing to preparation, the animals are in different degrees of extension; for this reason, body length will be neglected. Clypeus width in μm: 177-247 (holotype 222); $\bar{x}$ (n=35) 207; s=20, 25; v=9, 78. Width of posterior sternal plate in μm, measured on the widest part in the region of setae 3c: 90-127 (holotype 110); $\bar{x}$ (n=37) 106; s=10, 03; v=9, 46. Entire body surface is finely punctated.

Dorsum (Fig. 1): Free edge of clypeus with radial stripes. Setae cl and c2 with hair tubes. Cupulae ia and ip rounded.

Venter (Fig. 2, a): Illustration shows relative length of the ventral setae and their pinnation. Posterior genital sclerite is distinctly wider than long.

Setae: Setae ps1 and ps2 are pinnate; ps3 is present, at least half as long as ps1 and ps2, smooth (Fig. 1). Trichobothrium has a thin stalk and clubbed end with fine scales; trichobothrial setae are the same length (Fig. 3, a).

Legs: Leg I (Fig. 2, b-e): Formula of setae (solenidia in parentheses): trochanter 1, femur 2, genu 4, tibiotarsus 16 (4). Tibiotarsus distal with two setae sockets, no claw. Solenidia $\varphi_2 > \varphi_1 > \omega_2 \cong \omega_1$. Leg II (Fig. 3, b): Formula of setae: trochanter 1, femur 3, genu 3, tibia 4(1), Tarsus 6(1). Tarsus with small claws and pulvillus. Leg III (Fig. 3, c): Formula of setae: trochanter 1, femur 2, genu 2, tibia 4(1), Tarsus 6. Tarsus with small claws and pulvillus. Leg IV (Fig. 3, d): Formula of setae: trochanter 1, femur 2, genu 1, tibia 3, tarsus 4. Tibia and tarsus almost completely fused. Tarsus shortened; praetarsus strongly reduced, claw absent.

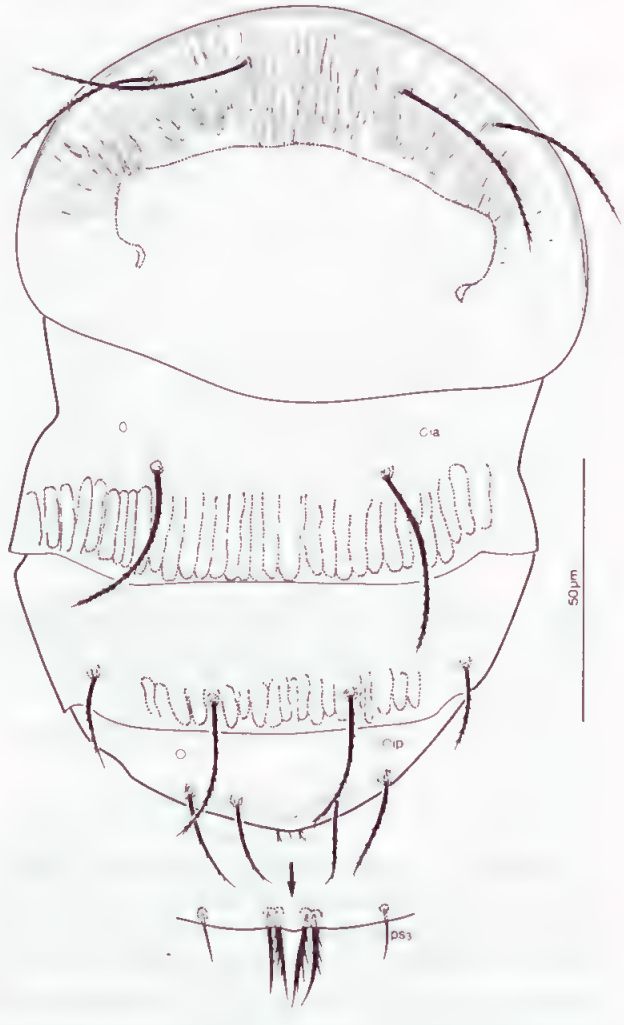

FIGURE 1. *Heterodispus longisetosus*, ♀ (holotype), dorsal view; setae ps1-ps3 in higher magnification.

Variability: The material examined is not significantly variable for systematically relevant characteristics.

Systematic position

Heterodispus longisetosus resembles, mainly due to the rudimentary tarsi IV, the species *H. conquassatus* Mahunka, 1972, *H. mussardi* Mahunka, 1975 and *H. reductus* Mahunka, 1971, but differs from the first two in different positions of the setae 4a as well as in the relative length of the body setae. *H. longisetosus* differs from *H.*

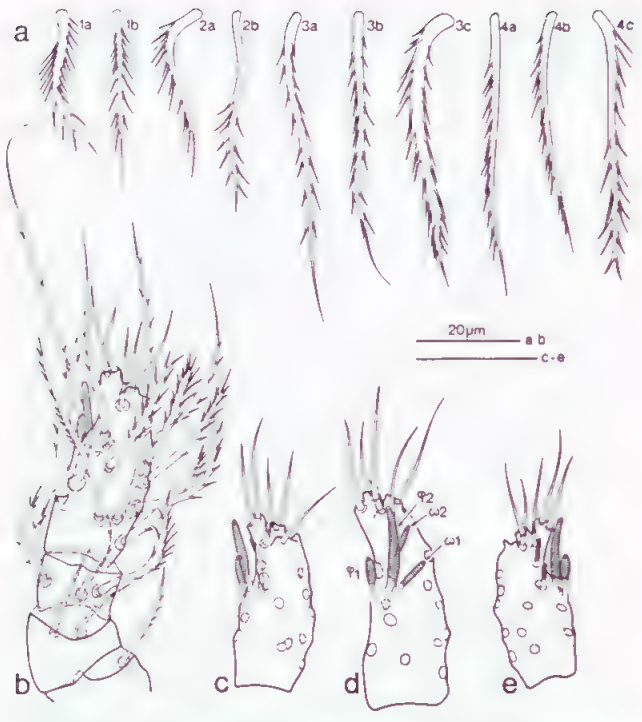

FIGURE 2. *Heterodispus longisetosus*, ♀; a, ventral setae (holotype); b, leg I in ventrolateral view; c–e, tibiotarsus I in different views (only distal setae are drawn).

reductus in the form of setae ps3 as well as in body and leg setae.

Remarks

Although the genus *Heterodispus* has only 26 species, the taxonomic problems are substantial, for the same reasons given by Ebermann (1988) for the genus *Imparipes*. The problem for the student of these species is the difficulty in differentiating new species from known material. The main reason for this is the lack of necessary details in the original descriptions. A first step to improving this situation would be generic revisions and, in some cases, supplementary descriptions of uncertain species are urgently needed. A further problem, which could also affect the genus *Heterodispus*, is that female

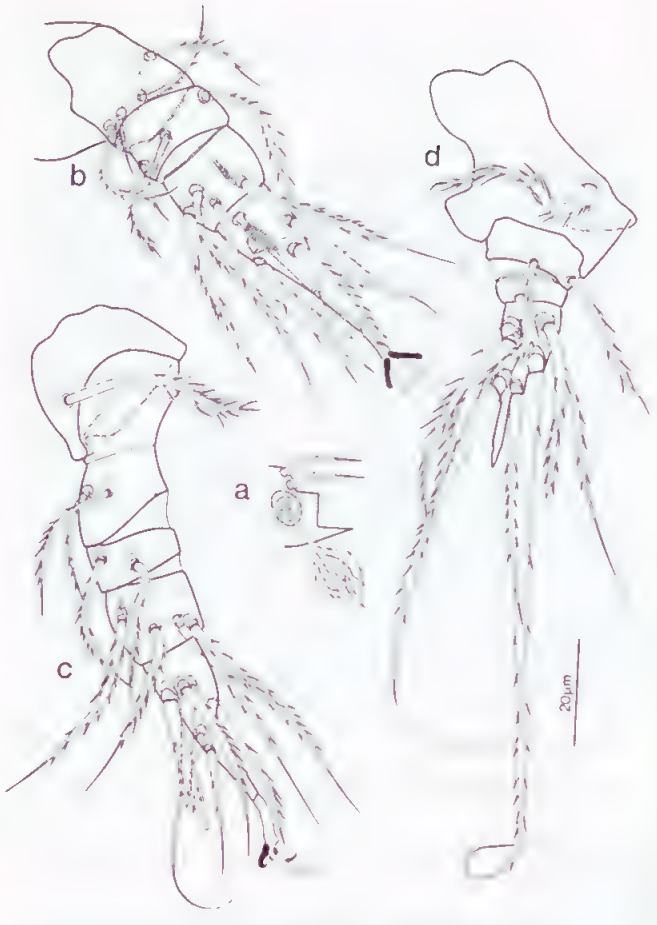

FIGURE 3. *Heterodispus longisetosus*, ♀; a, trichobothrium; b, leg II (ventral); c, leg III (ventrolateral); d, leg IV (ventrolateral). (b, c and d are drawn from various specimens.)

polymorphism occurs in scutacarids, first demonstrated by Norton (1977). New work of mine involving, among other things, the variation in the claws of leg I as well as in the setation of body and legs, has already shown a gradual and varying female dimorphism for various species of several genera (Ebermann in prep.). Female dimorphism in the genus *Heterodispus* has not yet, however, been demonstrated.

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15 DEC 1989

THE MAMMALS OF NORTH-WESTERN SOUTH AUSTRALIA

P. B. COPLEY, C. M. KEMPER & G. C. MEDLIN

COPLEY, P.B., KEMPER, C.M. & MEDLIN, G.C. 1989. The mammals of north-western South Australia. *Rec. S. Aust. Mus.* 23(2): 75–88.

In 1985 a three-week survey was made in parts of north-western South Australia to ascertain which species of mammals occurred in the region in the past and which of these are still present. Trapping and mist-netting yielded four species of small ground mammals and eight species of bats. Another 11 species were observed or their recent signs recorded. *Taphozous hilli* was collected and recorded for the first time in the state. Aboriginal names for mammals were recorded and verified from older published information. The Aboriginal people confirmed that many species no longer inhabited the region. Approximately 23 species of mammals were identified in owl pellets and surface bone deposits. *Pseudantechinus macdonnellensis* was recorded for the first time in South Australia but only in the oldest deposit which contained several species believed to be extinct in the state. The remains of *Mus domesticus* were found in owl pellets and loose material at all four collection sites.

Forty-three species of indigenous mammals have now been recorded from the north-west of South Australia but only 20 (46%) of these are considered extant. *Petrogale lateralis* appears to be declining in numbers, with only a few populations remaining. We recommend that these be monitored closely and that steps be taken to protect them.

P.B. Copley, National Parks and Wildlife Service, Department of Environment and Planning, 55 Grenfell Street, Adelaide, South Australia 5000; C.M. Kemper, South Australian Museum, North Terrace, Adelaide, South Australia 5000 and G.C. Medlin, Mawson High School, Colton Avenue, Hove, South Australia 5048. Manuscript received 29 March 1988.

Many arid zone mammal species have undergone drastic changes in distribution and status since European man first settled Australia (Jones 1923–25; Finlayson 1961; Burbidge & Fuller 1979, 1984; Strahan 1983; Burbidge *et al.* 1987; Burbidge *et al.* 1988). The magnitude of this decline will probably not be fully realised until the original faunas become better known through more studies of surface bone deposits and owl pellets. From these sources, Morton & Baynes (1985) have concluded that the extant species, at least among rodents and polyprotodont marsupials, are much reduced in both distribution and abundance when compared with pre-European times.

As early as the mid-1920s, Jones (1923–25) documented the alarming decline of many South Australian species and in 1961 Finlayson concluded that the decline was continuing. At the present time 22 (21%) of the 103 non-marine, native mammal species recorded in South Australia are presumed extinct in the state (Aslin 1985). Much of our knowledge of the mammals of north-western South Australia (and in fact much of central Australia) is due to the work of Finlayson (1935, 1961). He last recorded many of the species now believed extinct in the state in the period from 1931 to 1935.

Other studies before and since Finlayson's time have reported on the mammals of the north-west. These include the Elder Expedition of 1891–1892 (Stirling & Zietz 1892), the Government North-West Expedition of 1903 (Basedow 1915), the White Expedition of 1914 (White 1915) and the records of Philpott & Smyth (1967).

Finlayson often documented the Aboriginal names for the mammal species he discussed. More recently, Burbidge & Fuller (1979, 1984), Burbidge *et al.* (1987) and Burbidge *et al.* (1988), have sought information on the past and present status of mammals in the desert regions of central Australia in general and Western Australia in particular. Museum skins, to which the Aborigines could immediately relate, consistently elicited the names reported by Finlayson (1961). This survey technique was also adopted by Friend *et al.* (1982) when looking for numbats (*Myrmecobius fasciatus*) and by Southgate (in press) when carrying out research on bilbies (*Macrotis lagotis*).

In September 1985 we visited the Pitjantjatjara lands of north-western South Australia to conduct a rapid survey of the region's mammal fauna. The survey utilised three different methods: 1) collecting skeletal remains from owl roosts and surface bone deposits; 2) observing and/or capturing extant species; and 3) obtaining information from local Aborigines. The results of the survey were then compared with previous records from Australian museums and published literature.

Materials and Methods

Figure 1 illustrates the route taken, sites sampled, Aboriginal communities visited and other features

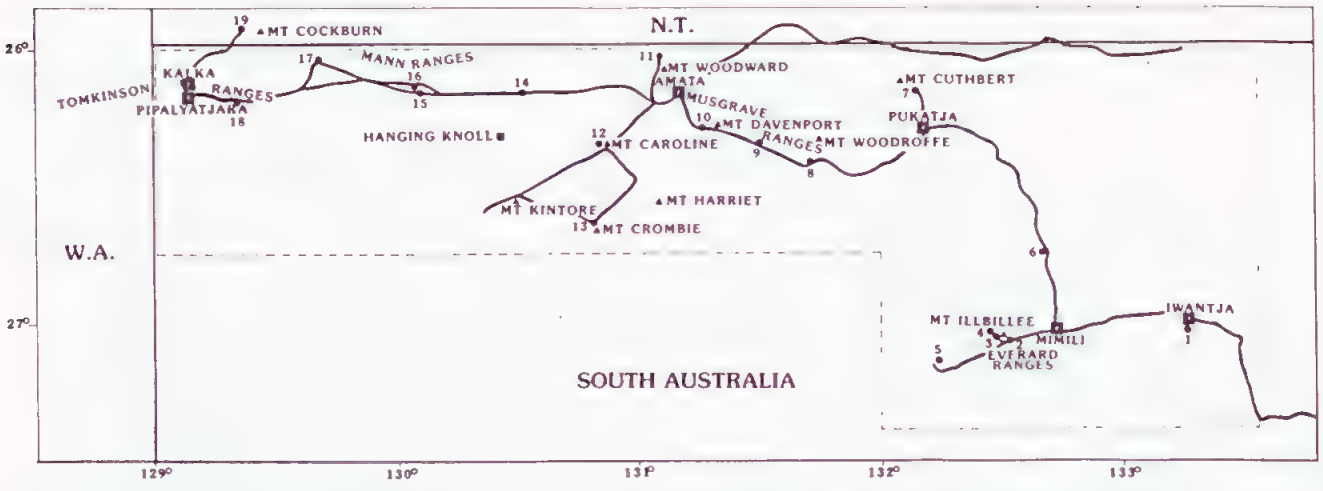

FIGURE 1. Area surveyed for mammals during the September 1985 trip to the north-west of South Australia. --- areas searched for museum records; —— route taken; ▲ mountain; ● collection/observation site. Aboriginal communities visited (■) were Mimili (Everard Park), Amata (Musgrave Park), Pipalyatjara (Mt Davies Camp), Iwantja (Indulkana), Pukatja (Ernabella) and Kalka. Numbers are collection/observation sites and refer to localities listed in Table 1.

of interest in the survey area. Table 1 lists and describes the localities where our specimens were collected or where important observations were made.

Museum collections at the Australian Museum (AM), Western Australian Museum (WAM), Central Wildlife Collection of the Northern Territory Museum of Arts and Sciences (NTM) and South Australian Museum (SAM) were searched for previous mammal records from the area delineated. However, only the most recent specimens are referred to in the 'Results' section.

Owl pellets and surface bone deposits

Skeletal material was collected from five owl roosts at four sites in the study area. Whole or fragmentary pellets were dissected in the manner described by Medlin (1977). Their contents and the

TABLE 1. Localities where mammals or mammal remains were recorded during the 1985 survey. Locality numbers 1-19 are shown on Fig. 1. Aboriginal names refer to general region when applicable.

Site no.	Locality	Lat./long.	Aboriginal name
1.	Warkarrecoordinna Rockhole, S.A.	26°59′S 133°15′ E	Warkarrikurti-nya
2.	1 km N Victory Well, S.A.	27°03′S 132°30′ E	
3.	3 km SE Betty Well, S.A.	27°03′S 132°27′ E	
4.	0.5 km E Betty Well, S.A.	27°02′S 132°26′ E	
5.	Eteamerta Hill, S.A.	27°08′S 132°13′ E	
6.	25 km N Artoonanna Hill, S.A.	26°44′S 132°38′ E	
7.	7 km SE Mt Cuthbert, S.A.	26°07′S 132°06′ E	Wamikata
8.	11 km SSW Mt Woodroffe, S.A.	26°24′S 131°42′ E	near
9.	18 km SE Mt Davenport, S.A.	26°21′S 131°28′ E	Erlywanjawanja
10.	8 km SW Mt Davenport, S.A.	26°17′S 131°15′ E	Rockhole
11.	4 km NNW Mt Woodward, S.A.	26°01′S 131°04′ E	
12.	2 km E Mt Caroline, S.A.	26°21′S 130°51′ E	Ulkiya
13.	3 km NW Mt Crombie, S.A.	26°38′S 130°48′ E	Ulpurra
14.	8 km ENE Njungunja Rockhole, S.A.	26°10′S 130°30′ E	
15.	4 km W Kapi Kanbina Rockhole, S.A.	26°08′S 130°04′ E	Kapi Kanpi
16.	6 km W Kapi Kanbina Rockhole, S.A.	26°08′S 130°03′ E	Kapi Kanpi
17.	Katjawara Soak, S.A.	26°02′S 129°40′ E	
18.	15 km E Mt Davies Camp, S.A.	26°11′S 129°17′ E	
19.	7 km NW Mt Cockburn, N.T.	25°55′S 129°21′ E	

loose bones collected from roost floors were identified using museum reference material as well as published descriptions of cranial/dentary measurements and features. Counts of left or right dentaries or maxillae yielded minimum numbers of individuals. No attempt was made to identify hair.

Mammal capture and observation

Small terrestrial mammals were captured in pitfall traps and/or baited, metal box traps (Elliott Scientific Company, 9 × 9 × 30 cm) set at six sites (1, 2, 10, 13, 15/16; Fig. 1). Six nights of box trapping gave 675 trapnights and seven nights of pitfall trapping gave 170 pitnights.

Mist-nets and harp traps were set at nine sites (total of 12 nights) in likely bat flyways *i.e.* along creek beds, over tanks and dams or around flowering trees. Specimens were collected by hand from caves at three sites (4, 7, 18; Fig. 1).

Animals were killed with nembutal then weighed and measured before tissues (liver, kidney, heart) were removed for later isozyme electrophoresis. Specimens were fixed in 10% formalin and later transferred to 70% ethanol for storage. Identifications were verified by isozyme electrophoresis for the following species: *Taphozous hilli, Scotorepens balstoni, Eptesicus baverstocki, Eptesicus finalysoni, Sminthopsis ooldea, Ningaui ridei, Pseudomys hermannsburgensis.*

Observations were made of medium to large mammals and their scats and tracks were noted.

Aboriginal knowledge

Interviews were held at six Aboriginal communities (Fig. 1) where the languages used were primarily Pitjantjatjara and Yankunytjatjara, with some Ngaanyatjarra and Ngaatjatjarra. At each community we showed the people museum skins of a range of mammal species, as well as a portion of a stick-nest rat's nest, with a view to learning the local name(s) of each species, its habits and its past and present status in the region. Elder community members usually contributed the most information. These included two men and one woman who acted as guides for parts of the survey.

Orthography of Aboriginal names follows that used by Burbidge *et al.* (1988).

Results

Owl pellets and surface bone deposits

Twenty-three species of mammals were identified from owl pellets and surface bone deposits (Table 2). Of these species, 17 were in loose material only, three were in pellets only and six were in both types of samples. Two species of dasyurid marsupials (*Sminthopsis ooldea* and *Ningaui ridei*) and two species of rodents (*Mus domesticus* and *Pseudomys cf. hermannsburgensis*) dominated the samples in terms of abundance of individuals and representation at three or four sites. Inverse proportions of *M. domesticus* and *P. cf. hermannsburgensis* were noted at sites 9 and 12. Dasyurids were less numerous than rodents. In addition, at least five species of bats were recorded; however only *Chalinolobus gouldii, Eptesicus finlaysoni* and *E. baverstocki* were found in pellets. Those bats occurring in loose material (including a further two species) may not have been the prey of owls.

Owl pellets from sites 6, 9 and 12 were, at the time of collection, intact, black and with the shiny, mucous coat still relatively unchanged. The pellets were found on the surface — not partly buried — and had not been trampled or crushed by animals which had access to the sites. In addition, on return, pellets in sealed plastic bags were found later to contain adults of the clothes moth, *Tineola bisselliella*. These factors together support our view that the pellets were of relatively recent origin *i.e.* probably deposited within the past 12 months. On this basis, *Pseudomys desertor*, which was present in pellet material at site 12, as well as in loose material at sites 6 and 12, is probably still extant in the region.

Conversely, we believe that the deposit of surface bone material at site 6, north of Artoonanna Hill, is the oldest that we sampled. All material found there was fragmentary and imbedded in sediment. Four extinct species — *Chaeropus ecaudatus, Pseudomys gouldii, Leporillus apicalis* and *Notomys longicaudatus* — were identified in this material. A further five species were recorded there but not at other sites (*see* Table 2).

Mus domesticus remains were found at all sites, including site 6. The minimum number of species in loose material was 23, that in pellets was 9. Site 9, near Mt Davenport, was the richest site for bat remains. The 'minimum number of species' has been used in summarising the owl pellet data as skull material referable to *Pseudomys hermannsburgensis* and *Notomys alexis* is often difficult to distinguish from skull characteristics of similar-sized *Pseudomys* or *Notomys* species (*e.g. P. bolami* and *N. fuscus*). In these instances known distributions and captures of live animals close to the sites were taken into account in making the final determination. This also applies to the tentative identification of *Sminthopsis cf. hirtipes*, for which only a single dentary was found.

Captures and observations

Four species of small ground mammals and eight species of bats were captured during the survey. These are detailed in the annotated species list which follows.

TABLE 2. Mammal species recorded in whole or broken owl pellets (right) and loose bone material (left) from owl roosts in north-western South Australia. Values are minimum number of individuals. All samples from site 6 were loose material; all from site 19 were whole pellets. *See* Table 1 and Fig. 1 for location of sites.

Species	Site no. 6		9		12		19	
DASYURIDAE								
Antechinomys laniger	1	–	0	0	0	0	–	0
Dasycercus cristicauda	2	–	0	0	0	0	–	0
Ningaui ridei	1	–	1	9	4	9	–	2
Pseudantechinus macdonnellensis	0	–	2	0	1	0	–	0
Sminthopsis cf. hirtipes	0	–	0	0	1	0	–	0
S. ooldea	1	–	10	0	1	0	–	1
PERAMELIDAE								
Chaeropus ecaudatus	1	–	0	0	0	0	–	0
CHIROPTERA Gn. sp.	0	–	3	0	0	0	–	0
Chalinolobus sp.	0	–	1	0	0	0	–	0
C. gouldii	0	–	0	0	0	1	–	0
Eptesicus finlaysoni	0	–	0	1	0	0	–	0
E. baverstocki	0	–	0	1	0	0	–	0
Mormopterus sp.	0	–	2	0	0	0	–	0
Nyctophilus geoffroyi	0	–	1	0	0	0	–	0
MURIDAE								
Leggadina forresti	2	–	0	0	0	0	–	0
Leporillus apicalis	2	–	0	0	0	0	–	0
Mus domesticus	26	–	1072	204	163	512	–	4
Notomys sp.	116	–	0	0	0	0	–	0
Notomys cf. alexis	0	–	2	0	0	3	–	0
N. longicaudatus	7	–	0	0	0	0	–	0
Pseudomys desertor	1	–	0	0	3	9	–	0
P. gouldii	23	–	0	0	0	0	–	0
Pseudomys sp./*Notomys* sp.	66	–	0	0	0	0	–	0
P. cf. hermannsburgensis	35	–	123	44	15	239	–	3
Rattus villosissimus	2	–	0	0	0	0	–	0
LEPORIDAE								
Oryctolagus cuniculus	0	–	2	0	0	0	–	0
No. of whole pellets	0		48		180		8	
Total no. of individuals	286	–	1219	259	188	773	–	10
Min. no. of species/site	14	–	11	5	7	6	–	4

Annotated list of mammal species

The following list summarises information obtained from all available sources. It includes the Aboriginal name(s) for each species and, where possible, Aboriginal knowledge about each species' past and present distribution. Species marked with an asterisk were not shown to Aborigines as either museum skins or live-caught individuals. The last known record for each species within the study area — either as a museum specimen or as an observation referred to in the literature — is also given.

MONOTREMATA

Tachyglossidae

**Tachyglossus aculeatus*, short-beaked echidna

Aboriginal names: *tjilkamarta, tjirilya*

Last record: 1966 (Philpott & Smyth 1967); this survey (droppings, diggings)

Comments: We found echidna diggings and droppings on nearly every hill we climbed during our travels. However we did not encounter the animal itself. Aborigines from Mimili and Amata used both names but *tjilkamarta* was used elsewhere. A woman from Mimili told us how the

animal was killed and the meat was then removed from the ventral surface.
Regional status: widespread

MARSUPIALIA
POLYPROTODONTA

Dasyuridae

**Antechinomys laniger*, kultarr
Aboriginal name: *mingkiri* (*see Sminthopsis* spp.) (Burbidge *et al.* 1988)
Last record: 1933 (SAM); this survey (loose bone material)
Comment: This is another species recorded recently in adjoining areas to the south-east, west and north. It is probably extant in the north-west of the state.
Regional status: indeterminate

Dasycercus cristicauda, mulgara
Aboriginal names: *murrtja, nyalurti* (Finlayson 1961, Burbidge *et al.* 1988), *mingkiri* (this survey, Burbidge & Fuller 1979, Burbidge *et al.* 1988).
Last record: <1933 (SAM), this survey (loose bone material)
Comments: All people we spoke with used the word *mingkiri* for most small dasyurids and rodents. However, specimens with brush tails were usually given other names as well. Unfortunately, there was no consistency with the use of these other names and we have to rely on Finlayson (1961) and Burbidge *et al.* (1988) as indicators of accuracy.

We were told the name *murrtja* at Mimili and Amata in reference to a specimen of *Dasyuroides byrnei* and at Kalka the name *nyalurti* was applied to a specimen of *Pseudantechinus macdonnellensis*. Both names Finlayson (1961) referred to *Dasycercus cristicauda* and this has been supported by the work of Burbidge *et al.* (1988). At Kalka and Pipalyatjara, our specimen of *D. cristicauda* elicited the name *anoola* which Finlayson referred to *Pseudomys (Leggadina) waitei (= Leggadina forresti)*. Thus it would appear that the names are still known but are now no longer applied accurately, either because the animals no longer exist in the region or because they are no longer hunted and/or encountered by the local people.
Regional status: Although not recorded for the region for more than 50 years, this species has been recorded nearby, to the south-east, west and north in the past 15 years. Most recently it has been captured near Ayers Rock in Uluru National Park (Masters 1989). It is therefore likely that more detailed survey work will find this species within the survey area. Its status is therefore indeterminate.

**Dasyurus geoffroii*, western quoll
Aboriginal name: *parrtjarta*
Last record: <1931 (SAM) (*see* also Johnson & Roff 1982)
Comments: At Mimili the name was included (unsolicited) in a list of the *kuka* (= meat animals) which an informant's father used to hunt. At Pipalyatjara one old man told us that he used to catch *parrtjarta* by spearing them while they were cornered in a hollow in a tree. Both informants said that this species had been gone for a long time.
Regional status: extinct

Ningaui ridei, wongai ningaui
Aboriginal name: *mingkiri* (*see Sminthopsis* spp.)
Last record: 1974 (WAM); this survey (captured)
Comments: This species was captured in pitfall traps at sites 2, 13 and 16 (Fig. 1). Single specimens were captured at sites 2 and 16 and five individuals were captured at site 13. They were caught in habitats ranging from tussock and hummock grassland to desert shrubland, on sandy or rubbley-loam soils. *Triodia* sp. hummocks were present at each site.
Regional status: widespread and probably common

Pseudantechinus macdonnellensis, fat-tailed antechinus
Aboriginal name: *nyalurti*(?) (Burbidge & Fuller 1979)
Last record: this survey (loose bone material)
Comments: This species was first recorded in South Australia from owl pellet deposits at sites 9 and 12 (this study). As it was found only in loose skeletal material (rather than intact pellets) it is likely that these are old specimens. Aborigines at Kalka used the name *nyalurti* for this species and probably confused it with *D. cristicauda.*
Regional status: As this species is common in rocky ranges of adjoining parts of Western Australia and the Northern Territory, further detailed survey work may find it in the survey area. Its status is therefore indeterminate.

Sminthopsis spp., dunnarts
Aboriginal name: *mingkiri* — a generic term for all small dasyurids and mice

**Sminthopsis hirtipes*, hairy-footed dunnart
Last record: this survey (loose bone material)
Comment: No previous record from the region but recorded recently from the Great Victoria Desert to the south and west and Uluru National Park to the north.
Regional status: indeterminate, but probably present in sandy habitats across the study area. (The recently described desert dunnart, *S.*

youngsoni, which occurs with *S. hirtipes* in sandy areas of Uluru National Park, may also eventually be found in north-western South Australia).

**Sminthopsis macroura*, stripe-faced dunnart
Last record: <1975 (SAM owl pellet material)
Regional status: indeterminate, but probably locally common in suitable habitats

Sminthopsis ooldea, Ooldea dunnart
Last record: <1975 (SAM owl pellet material); this survey (captured)
Comments: Three individuals were captured in pitfall traps at site 15 (near Kapi Kanpi, Fig. 1). They were trapped in an open woodland of *Hakea ivoryi* and *Acacia estrophiolata* with a grassy understorey of *Aristida* sp. The two males captured both had enlarged prostate glands (evidence of mating condition) and the female showed signs of having mated recently, but had no pouch young.
Regional status: probably widespread and common

Myrmecobiidae
Myrmecobius fasciatus, numbat
Aboriginal name: *walpurti*
Last record: <1936 (SAM)
Comment: The numbat is a widely known species in the Pitjantjatjara Lands, mostly through association with dreaming stories, especially in the Everard Ranges. However, with the exception of observations from a few older men, first-hand accounts of this animal were difficult to obtain. One old man at Kalka (about 70 years of age) told us that he knew it from an area south of the Mann Ranges, but had only seen it when he was a boy. Other old men at Mimili could remember the *walpurti* but also only from their childhood. They said that it used to occur around Mintabie and Mimili. All who knew it said that it was good *kuka* (meat).

Friend *et al.* (1982) have summarised the natural history of this species related to them by central Australian Aborigines. In this they concluded that the desert populations of the rusty numbat (*M. fasciatus rufus*) are almost certainly extinct and gave the time of the last Aboriginal sighting as the late 1960s.
Regional status: extinct (*see* Friend *et al.* 1982)

Notoryctidae
Notoryctes typhlops, marsupial mole
Aboriginal name: *itjaritjari*
Last record: 1986 (SAM)
Comment: Most people recognised this animal immediately and many said that they had seen it recently. All said that it lives in sandhill country.
Regional status: Although recorded infrequently, this species is likely to be widespread in sandy areas of the region.

Peramelidae
**Chaeropus ecaudatus*, pig-footed bandicoot
Aboriginal name: *kanytjilpa* (Finlayson 1961)
Last record: 1901 (SAM); this survey (loose bone material)
Comment: We did not show a skin of this species, nor did we hear the people using the name — *kanytjilpa* — that Finlayson (1961) and Burbidge *et al.* (1988) have reported for it. A lower jaw of this species was found in a surface bone deposit in an old owl roost at site 6 during our survey.
Regional status: extinct

Isoodon auratus, golden bandicoot
Aboriginal names: *wintarru, nyurlu, makurra*
Last record: 1933 (SAM)
Comment: Many middle-aged and older people at each community readily recognised this species by referring to the coarse texture of its fur and the appearance of its head, feet and tail. It was clearly a former food item and the informants took great delight in demonstrating how they captured it. The bandicoot sheltered in a nest of grass situated between grass tussocks. When this was located the people crept up on it and immobilised the occupant by placing a hand or foot firmly on top of it. All informants stated that this species was now 'finished'. Finlayson (1961) noted that the Pitjantjatjara names for this bandicoot were *wintaroo* (= *wintarru*) and *nyurloo* (= *nyurlu*) and that the Ngaatjatjarra from further west call it *makoora* (= *makurra*). We were given the first two names only at Ernabella, and the latter name only at Kalka. Elsewhere, all three names were provided.
Regional status: extinct

Macrotis lagotis, greater bilby
Aboriginal names: *tjarlku, nirnu, marrura*
Last record: 1933 (SAM)
Comment: This species was well known to all groups with whom we spoke. The name *tjarlku* was used at Indulkana, Mimili and Amata; *nirnu* at Mimili, Ernabella, Amata, Pipalyatjara and Kalka; and *marrura* at Ernabella. At Pipalyatjara one old man told us that *nirnu* tails used to be worn ceremonially in men's beards. None of our informants knew of any extant populations in South Australia. The nearest they knew of (at Pipalyatjara and Kalka) was in the Kintore Ranges in the Northern Territory (*ca* 300 km to the north).
Regional status: probably extinct

**Perameles eremiana*, desert bandicoot
Last record: <1936 (SAM)
Perameles bougainville, western barred bandicoot
Last record: 1931 (SAM)

Aboriginal name: *walilya*
Comment: The South Australian Museum has three specimens of *Perameles bougainville* from 'south of Mt Crombie' registered in 1931. Mt Crombie is situated 'south of the Musgrave and Mann Range', a location Finlayson (1961) cited for *P. eremiana*, not *P. bougainville*. At Pipalyatjara and Kalka, our specimen of *P. bougainville* was readily recognised by the name *walilya*. However, at other communities the responses of our informants were mostly indecisive and confused. Some said that it was a small *wintarru* or *nyurlu* (*i.e. I. auratus*). Others simply did not know it.
Regional status: extinct (both species)

DIPROTODONTA

Phalangeridae

Trichosurus vulpecula, common brushtail possum
Aboriginal names: *wayurta, mungawayurru*
Last record: 1966 (SAM, mummified remains); this survey (old scats)
Comments: Most older people recognised this species and claimed that it used to be common. No-one knew of its existence in this part of South Australia, and most thought that it was 'finished' many years ago. However, some people at Kalka and Pipalyatjara thought they still occurred in the gum-lined creeks in the Petermann Ranges in the south-west of the Northern Territory. The only signs of possums we found were old droppings which were in caves where they had been protected from weathering. These were found near Betty Well in the Everard Ranges, and on Mt Kintore, about 80 km south-west of Amata. Aitken (unpublished notes, 1966) also found droppings and skeletal remains 'at a small cave opposite Kumbi Rock Hole . . . approximately 4 miles south of the main road' (presumably near Piltardi at the eastern end of the Mann Ranges).

Several common brushtail possums were released near Ernabella in the early 1970s (R. Henderson, S.A. National Parks and Wildlife Service, pers. comm.). Unfortunately, they have not been recorded in the area since and are considered by many to be extinct. However, they are known to occur in very low densities in a small area of the Petermann Ranges, only 100 km north of the South Australian/Northern Territory border and detailed surveys may locate them again south of the border.
Regional status: apparently extinct but more intensive surveys needed (*see* Foulkes & Kerle 1989)

Potoroidae

Bettongia lesueur, burrowing bettong
Aboriginal name: *mitika, tungku*
Last record: <1931 (SAM)
Comment: A few older men at Indulkana and Mimili recognised this species and each used both names. They stated that it had not been seen for a long time. It was unclear as to whether the word *tungku* (which means short and stumpy) was their name for it or simply a description of the animal.
Regional status: extinct (*see* Burbidge *et al.* 1988)

**Bettongia penicillata*, brush-tailed bettong
Aboriginal name: *karrpitji* (Finlayson 1961, Burbidge *et al.* 1988)
Last record: ?1930s (Finlayson 1961)
Comments: We did not obtain information about this species. However, Finlayson (1961: 169) recorded that this bettong was, 'still extant in very small numbers on both sides of the South Australian (Northern Territory) border in 1932–35, where specimens were obtained by the blacks'.
Regional status: extinct (*see* Burbidge *et al.* 1988)

Macropodidae

**Lagorchestes hirsutus*, rufous hare-wallaby
Aboriginal name: *mala*
Last record: 1933 (SAM)
Comment: Many of the middle-aged and especially older people we spoke with pointed out that hare-wallabies used to occur in spinifex country in the region and that they were good meat. However, none of them knew of any remnant populations. Aitken noted in 1966 (unpublished journal) that they were 'now extinct, apparently'.
Regional status: extinct [Burbidge *et al.* (1988) give the most recent Aboriginal sighting of this species in the region as 30 years ago near Amata.]

**Macropus robustus*, euro
Aboriginal name: *kanyala*
Last record: this survey (sighted)
Comment: The euro is widespread and common in all rocky country. It is hunted by the local people, but red kangaroos and perenties (*Varanus giganteus*) appear to be favoured.
Regional status: widespread and common

Macropus rufus, red kangaroo
Aboriginal name: *marlu*
Last record: ?this survey (specimen and sighted)
Comment: Red kangaroos are fairly common in mulga country, especially where ground cover is tussock grass rather than spinifex. They are keenly hunted by the local people using rifles. As a consequence they were uncommon around settlements and were nowhere abundant in areas we traversed. We collected one specimen, a pouch young (M12724), 15 km NNE of Mt Crombie.
Regional status: widespread at low densities

**Onychogalea lunata*, crescent nail-tailed wallaby
Aboriginal name: *tjawalpa*
Last record: 1891 (SAM)
Comment: Aboriginal people at Indulkana and Mimili used this species' name and claimed to have eaten it when they were younger. All stated that it was no longer around. Aitken noted in his journal records during a trip to the region in February 1966 (unpublished):

> One of the main reasons for going to Itari [near Dry Hill, and about 40 km east of Mt Lindsay] was to check on the reports of a wallaby still living in the area. These may quite well still be there but we were not in fact to locate them . . . the wallaby from description is obviously *Onychogalea lunata* the Crescent Nail-tail [sic], which in this country lives by burrowing under a shady shrub or tree during the day and partially covering itself with sand and debris. It ventures forth at night to feed . . . [Here] the vegetation was predominantly mulga with patches of sparse mallee. The undergrowth was of spinifex, native grasses, bunyeroo [sic], three-cornered jack and bindyi.

Regional status: extinct

Petrogale lateralis, black-footed rock-wallaby
Aboriginal name: *warru*
Last record: 1966 (Philpott & Smyth 1967); this survey (sighted)
Comment: We observed three black-footed rock-wallabies in the vicinity of a large cave at Wamikata (site 7, Fig. 1) in the Musgrave Ranges. The entrance to the cave was mostly blocked by fallen boulders behind which were two large chambers. Rock-wallaby faecal pellets littered the floors of both of these. We collected skeletal remains of one wallaby (M12555) in the cave.

We also found fresh rock-wallaby faecal pellets at one site (5) in the Everard Ranges and two sites (14, 17) in the Mann Ranges. We found old rock-wallaby faecal pellets in caves near:
1) Warkarrecoordinna Rockhole (site 1)
2) near Betty Well (sites 3, 4)
3) Mt Kintore (26° 34′S, 130° 30′E)
4) Mt Caroline (26° 21′S, 130° 51′E) and
5) un-named hill (26° 08′S, 130° 00′E) about 10 km west of Kapi Kanpi Rockhole.

Local people told us that rock-wallabies also still occur at:

1) an un-named hill near New Well (approx. 26° 07′S, 132° 12′E) about 8 km east of the Wamikata site
2) an un-named hill on the eastern side of the Ernabella airstrip (approx. 26° 16′S, 132° 11′E)
3) Mt Harriet (26° 32′S, 131° 05′E) about 45 km south of Amata
4) some un-named hills (26° 24′S, 130° 50′E) about 8 km south of Mt Caroline; and
5) an unspecified area north-west of Angatja homeland and probably to the NNE of Mt Winham (approx. 26° 02′S, 130° 16′E).

Unfortunately, we were unable to include these in our itinerary.

Aboriginal informants told us that when they were children, rock-wallabies used to be more widespread and abundant and that they frequently killed them for food. One man from Amata showed us how he used to sit in a strategic place amongst some rocks and whistle quietly to lure the inquisitive rock-wallabies out of their hiding place so that he could spear them. Their numbers have apparently declined dramatically and we were told of numerous places from which they have disappeared.
Regional status: declining populations; probably endangered by predation, especially by the introduced fox (*see* Kinnear 1989)

EUTHERIA
CHIROPTERA
Aboriginal names: Aboriginal people we spoke with constantly used one word — *pitjantjarra* — to describe all bats. However, they distinguished cave-dwelling bats with the additional name — *patupiri*. At Kalka, the name *ulpurulpuri* [also recorded by Finlayson (1961) as *oolpoolparrie*] was also given for a special cave-dwelling 'bat' which roosted in a small mud nest. The nests, which were shown to us, were those of fairy martins, but it was not possible to ascertain whether the name actually refers to the bird, or to a small bat which used deserted nests. Goddard (1986) concluded that the name *patupiri* also applied to fairy martins. The name is therefore probably used in a general way by many people to refer to cave-dwelling fauna. Another name, *tjinytjinytji*, has been recorded by Burbidge & Fuller (1979) and Burbidge *et al.* (1988) as a general word for bats but we were told that it referred to an insect (probably a cricket). The name may therefore also be used in a general way to mimic the high-pitched noises of both bats and crickets.

Megadermatidae
Macroderma gigas, ghost bat
Aboriginal name: *tjalku-tjalku* (Burbidge *et al.* 1988) — the only bat of the region with a unique name
Last record: *ca* 1920 (Finlayson 1961)
Comment: This most distinctive bat was recognised by the Aborigines with its own name. Older men at Amata told us of two localities for large, white bats (*Macroderma gigas*?) but we

could not determine whether the animals still occurred there. The localities were Aparina Creek (=Apari-nya Karu, J. Willis pers. comm.), near site 11 (Fig. 1, Table 1) and Cave Hill (26° 92′S, 131° 21′E) about 24 km NE of Amata.
Regional status: probably extinct (*see* Burbidge *et al.* 1988)

Emballonuridae

Taphozous hilli, Hill's sheathtail-bat
Last record: this survey (captured)
Comment: This species was first recorded for South Australia during the 1985 survey. It was found in two cave roosts, one at site 4 in the Everard Ranges, the other at site 7 in the Musgrave Ranges (*see* Fig. 1). At both roosts, the bats were located in narrow crevices off the main chambers. Two specimens were collected at site 4, and three (of five captured) at site 7.
Regional status: probably locally common

Molossidae

**Mormopterus planiceps*, little mastiff-bat
Last record: this survey (loose bone material)
Comment: Two skulls of this small bat were recorded in loose bone material from an owl roost at site 9 on the south side of the Musgrave Ranges (*see* Fig. 1) during this survey. This species is very adaptable in its feeding and roosting habits (Richards, in Strahan 1983) and is probably widespread in the region.
Regional status: probably widespread and common

**Tadarida australis*, white-striped mastiff-bat
Last record: <1961 (AM); this survey (captured)
Comment: This high-flying bat was only captured over water at site 8, on the south side of the Musgrave Ranges, where 10 individuals were mist-netted (four retained).
Regional status: probably widespread and common

Vespertilionidae

**Chalinolobus gouldii*, Gould's wattled bat
Last record: 1963 (SAM); this survey (captured and owl pellets)
Comment: This common species was mist-netted at sites 1 (five captured, two retained), 2 (six captured, two retained), 8 (five captured, three retained) and 11 (one captured and retained) during the survey. All captures were made either over or adjacent to waterholes in gum-lined creeks of the Everard and Musgrave Ranges. Two of the females captured each had two small embryos.
Regional status: probably widespread and common

**Chalinolobus morio*, chocolate wattled bat
Last record: this survey (captured)
Comment: Before this survey, this common southern species was only known in central Australia from a cave-dwelling population near Alice Springs. However, it was mist-netted at five sites during the survey — the four where *C. gouldii* was captured, plus site 15, a waterhole-creekline habitat in the Mann Ranges. Several of the females captured were pregnant with either one or two embryos. One specimen was captured and retained at site 1, 20 (two retained) at site 2, three at both sites 8 and 11 (all retained), and one (released) at site 15.
Regional status: probably widespread and common

**Eptesicus baverstocki*, inland eptesicus
Last record: this survey (captured and owl pellets)
Comment: A single specimen of this newly described species was captured (and retained) during the survey. It was mist-netted over water at site 1, south of Indulkana.
Regional status: indeterminate, probably widespread

**Eptesicus finlaysoni*, little brown bat
Last record: 1984 (SAM); this survey (captured and owl pellets)
Comment: This newly described species was mist-netted over water at sites 2 (two specimens, both retained) and 8 (one specimen, retained) and captured in cave roosts at sites 7 (18, four retained) and 18 (one, retained) (Fig. 1).
Regional status: probably widespread and common in the vicinity of range country

Nyctophilus geoffroyi, lesser long-eared bat
Last record: <1961 (AM); this survey (captured and loose bone material)
Comment: This common species was captured at seven of the ten sites where bats were caught during the survey. Most of the females captured were found to be pregnant with two embryos. Nine specimens were captured at site 1 (three retained), one (retained) at site 2, two (retained) at site 8, one at both sites 11 and 12 (retained), and five at both sites 13 and 15 (all retained).
Regional status: widespread and common

**Scotorepens balstoni*, western broad-nosed bat
Last record: this survey (captured)
Comment: A single specimen of this species was captured (and retained) in a mist-net at site 11 (Fig. 1).
Regional status: indeterminate, probably widespread

**Scotorepens greyi*, little broad-nosed bat
Last record: 1966 (SAM)
Comment: Probably occurs throughout the range country.
Regional status: indeterminate, probably widespread

RODENTIA

Muridae

**Leggadina forresti*, Forrest's mouse
Aboriginal name: *mingkiri*
Last record: 1975 (SAM, owl pellet material); this survey (loose bone material)
Comment: Since a recent (1984) specimen was collected on Granite Downs station just outside the study area to the east, it is quite likely that this rare species is extant in the north-west.
Regional status: indeterminate

Leporillus apicalis, lesser stick-nest rat
(*Leporillus conditor*, greater stick-nest rat?)
Aboriginal name: *tjuyalpi*
Last record: 1933 (SAM); this survey (loose bone material)
Comment: Although both species of stick-nest rat (*Leporillus apicalis* and *L. conditor*) have been recorded from semi-arid and arid areas of South Australia, only *L. apicalis* has been collected in the north-west of the state. This was by anthropologist Norman Tindale and physician C.J. Hackett in 1933. Tindale (pers. comm.) states that:

> On 18 July 1933 while travelling with a clan-like group of Pitjandjatjara [sic] eastward from Wiluwilura, a native watering place and camp west of Mount Crombie on the south side of the Musgrave Ranges, we passed from a porcupine grassed plain with low undergrowth between widely spaced clumps of the grass into low mallee scrub country with some outcrops of kunkar limestone and a scattering of kurrajong trees. Almost immediately we saw the first of several twig mounds of a house-building rat. It was sheltered under a kurrajong tree and was some 5 feet [1.5 m] in diameter and 4 feet [1.2 m] high. The aborigines who were independent, since we were observers only, set fire to it but the inhabitants had already left. We saw several more of these nests within the next half mile or so [1 km] one of which was under a spreading mallee. All were set on fire. Fires drove out several of the 'tjuijalbi' [sic] from their 'ngura tjuijalbi' [sic] and [these were] seized by the dogs of the hunters. Two of the animals were secured by us for the South Australian Museum collection.

Part of this sequence of events was recorded on film ('Mann Ranges — 1933'), copies of which are held by the Board for Anthropological Research, University of Adelaide.

Few people at the communities we visited showed any signs of recognition of the stick-nest rat specimen (of the similar *L. conditor*) we had with us. However, more people responded to questions about the origins of portions of a stick-nest we showed them. They used the name *tjuyalpi* for the animals which built the nests which they said had a burrow beneath the pile of sticks. Opinion was divided as to whether the nests were built in caves or in the open, but one old man at Kalka told us that they were built in either situation. If they were out in the open the nests were placed amongst a lot of vegetation (*e.g.* around a bush), but not amongst spinifex clumps. The same informant told us that the nests contained an adult male and an adult female and up to four young. The nests measured about 1 m by 0.5 m, which he traced in the sand to demonstrate. Some old people had seen stick-nest rats when they were young, mostly about 45 to 50 years ago. All said that they ate the rats and that they were 'good meat'.

We searched for stick-nests in the numerous caves and rock overhangs we explored, but only found three small, burnt remnants — two near Betty Well (sites 3, 4) in the Everard Ranges and one in the north-western Mann Ranges (19). During our survey we also collected skeletal remains of two *L. apicalis* from an old owl roost at site 6. However, we found no signs of stick-nest rats or their nests in the country which Tindale (pers. comm.) described west of Mt Crombie.
Regional status: extinct

Mus domesticus, house mouse
Aboriginal name: *mingkiri*
Last record: 1972 (SAM); this survey (captured and owl pellets)
Comment: Finlayson (1961) noted that there were considerable numbers of house mice in the study area in 1932–35. During our survey they were only captured in close proximity to human settlements at sites 2 and 10 (Fig. 1). However, large proportions of this species were also recorded in old and recent owl pellet deposits at sites 6, 9, 12 and 19 (Table 2).
Regional status: widespread and locally common

Notomys alexis, spinifex hopping-mouse
Aboriginal name: *tarrkawara, mingkiri*
Last record: 1966 (SAM); this survey (owl pellets)
Comment: This species is well-known by the majority of Aboriginal people we talked with. However, many confused it with other specimens we had with us which had brush tails (*e.g. Dasycercus cristicauda, Dasyuroides byrnei*).

Notomys sp. tracks were pointed out to us on sandhill areas, on the north side of Mt Crombie and on the Northern Territory–South Australian border north of Kalka. We also collected many skeletal remains of *Notomys cf. alexis* and *Notomys* sp. in owl pellet deposits at sites 6, 9, and 12 — those at site 12 occurring in intact 'recent' pellets.
Regional status: widespread and common

Notomys longicaudatus, long-tailed hopping-mouse
Aboriginal name: ?
Last record: this survey (loose surface bone material)
Comment: Not previously recorded from north-western South Australia. Skull fragments of at least seven individuals were found in an old owl roost at site 6 just north of the Everard Ranges.
Regional status: extinct

**Pseudomys desertor*, desert mouse
Aboriginal name: *mingkiri*
Last record: 1933 (SAM); <1961 (AM); this survey (owl pellets)
Comment: This little-known mouse has recently been captured (1987 and 1988) at two sites in Uluru National Park (Kerle & Morton 1988). Along with the 'recent' remains found in intact owl pellets at site 12, it seems likely that this species may still occur in suitable habitats within the survey area. Kerle & Morton (1988) suggest that these suitable habitats include areas of dense grass.
Regional status: indeterminate, probably still extant

**Pseudomys gouldii*, Gould's mouse
Aboriginal name: *mingkiri*
Last record: this survey (loose bone material)
Comment: This small mouse had not previously been recorded from north-western South Australia. In this survey, we found the skeletal remains of 23 individuals in an old surface bone deposit at site 6, just north of the Everard Ranges.
Regional status: extinct

Pseudomys hermannsburgensis, sandy inland mouse
Aboriginal name: *mingkiri*
Last record: 1972 (SAM); this survey (captured)
Comment: Single specimens of this mouse were captured in pitfall traps at sites 2, 13 and 15 (Fig. 1). The first two specimens were caught in hummock grasslands on sandy soils. The last was caught in an open woodland habitat of *Hakea ivoryi* and *Acacia estrophiolata* with an understorey of *Aristida* tussock grasses. Numerous skeletal remains were also found at sites 6, 9, 12 and 19, with many of those at sites 9, 12 and 19 coming from recent intact owl pellets (Table 2).
Regional status: widespread and common

**Rattus villosissimus*, long-haired rat
Aboriginal name: ? *mingkiri*
Last record: 1975 (SAM, owl pellet material); this survey (loose bone material)
Comment: This species has probably only invaded this region in extreme plaguing situations (*see* Redhead 1983). The owl pellet material it has been found in does not appear to be of recent origin — skull fragments of only two individuals having been found at site 6 during this survey.
Regional status: extinct

LAGOMORPHA
Leporidae
**Oryctolagus cuniculus*, European rabbit
Aboriginal names: *rapita, nani*
Last record: this survey (sighted and loose bone material)
Comment: The European rabbit is common in the north-west of South Australia; however, its numbers appear to be concentrated along drainage lines and on stony alluvial plains fringing the ranges and outlying hills. In 1985, few signs of rabbits were seen more than 5 km from the ranges and they appeared to be absent from sandhill areas. They are a major food source for Aborigines. Maurice & Murray (in Finlayson 1961) recorded rabbits as already plentiful in the Musgrave Ranges in 1901.
Regional status: widespread and common especially in drainage areas

CARNIVORA
Canidae
**Canis familiaris dingo*, dingo
Aboriginal name: *papa*
Last record: 1957 (SAM); this survey (sighted)
Comment: Dingoes are another widespread and common species in the region. Tracks were seen in most areas visited and individuals or pairs were observed on many occasions, mostly in open country near the ranges where rabbits were most abundant.
Regional status: widespread, in low densities

**Vulpes vulpes*, fox
Aboriginal name: ?, *'torka'* according to Finlayson (1961)
Last record: this survey (sighted)
Comment: Finlayson (1961) observed that during his field work of 1932, foxes 'were found to be well known to natives and white doggers in the Everard and Musgrave Ranges, though still in quite small

numbers'. By the 1950s their numbers had increased significantly to the point where 'native hunters interrogated in 1956, stated that in the area immediately to the south of the Musgrave, Mann and Tomkinson Ranges (which yields most of their dog scalps), the fox now out numbers the dingo'.
Regional status: widespread, probably in low densities

Felidae

**Felis catus*, cat
Aboriginal name: ?
Last record: this survey (sighted)
Comment: Only one cat was seen during our survey, near Kapi Kanpi (site 15). However, local Aborigines claimed that they were seen frequently.
Regional status: widespread, probably in low densities

PERISSODACTYLA

Equidae

Equus caballus, wild horse (brumby)
Aboriginal name: ?
Last record: this survey (sighted)
Comment: Wild horses were seen only on the south side of the Musgrave Ranges where they were concentrated around the few remaining waterholes.
Regional status: locally common

ARTIODACTYLA

Camelidae

Camelus dromedarius, one-humped camel or dromedary
Aboriginal name: *camela*
Last record: this survey (sighted)
Comment: Camels are widespread in the north-west of South Australia and we encountered their distinctive pads and droppings in all areas we visited. We made several sightings of small groups of camels including cows with young calves. The largest group consisted of 12 individuals.
Regional status: widespread

Discussion

The Pitjantjatjara lands of north-western South Australia offer a unique opportunity to study and compare recent past and present mammal assemblages for the following reasons: (1) the environment is a combination of two vastly different forms — sand plain/dune systems and rocky ranges; (2) the ranges provide good shelter for owls and thus surface bone deposits are probably common; (3) many species now believed extinct in South Australia were last recorded there; (4) there is good documentation of the timing of these declines (Finlayson 1961); and (5) the lands are now under control of the Pitjantjatjara Aboriginal people and have mostly not been grazed by domestic stock for many years — if at all.

The present survey recorded 16 indigenous mammal species by observation or capture. Another nine species probably still occur in the region. A compilation of all known records for the north-west gives a total mammal species list of 50, seven of which are not indigenous to Australia. Compared with other regions of arid Australia for which lists have been made, this figure is high. McKenzie & Robinson (1987) listed 41 and 37 species, including introduced forms, for the Nullarbor Plain and Great Victoria Desert, respectively. Burbidge & McKenzie (1983) reported 42 species in the Great Sandy Desert. Sixteen species were listed during a recent survey of the Mabel Creek area of South Australia (Kemper *et al.* 1985).

Reasons for the richness of the mammal fauna of north-west South Australia are related to points 1–5 listed above. Since there are two quite different environments, sand plain/dune and rocky ranges, there are elements of the faunas adapted to both. For example, *Petrogale lateralis* and *Pseudantechinus macdonnellensis* are inhabitants of rocky outcrops, and *Chalinolobus morio, Eptesicus finlaysoni* and *Taphozous hilli* are cave-dwelling bats. On the other hand, *Notoryctes typhlops, Dasycercus cristicauda* and *Sminthopsis ooldea*, among others, live in sandy country.

The early work of Finlayson (1961, museum collections) documented many mammal species which now no longer occur in South Australia. Fortuitously, his work coincided with their population declines in the 1920s and 1930s. Finlayson often used Aboriginal knowledge of the species to augment his own findings and he also obtained many specimens from these people (but only two species of bats). The present survey focused on collecting bats with the result that this part of the fauna is now reasonably well known.

The present survey included two sources of information not normally used in mammal survey — Aboriginal knowledge and surface bone deposits/owl pellets. The latter was particularly important because it added several species not recorded by other means and one species, *Pseudantechinus macdonnellensis*, not previously recorded in South Australia. The problem with surface remains and very old pellets is that it is difficult to date such deposits. It is presumed that if *Mus domesticus* is present then the material has been deposited since European settlement *i.e.* during the last 200 years. For example, Johnson & Baynes (1982) found a good correlation between species compositions in surface deposits and early whole-specimen collections from the same area.

As a result of our investigations and others (Jones 1923–25, Finlayson 1961, Philpott & Smyth 1967,

Watts 1969, Burbidge & Fuller 1979, Friend *et al.* 1982, Southgate in press, Burbidge *et al.* 1987, Burbidge *et al.* 1988) we conclude that only 20 (46%) of the 43 indigenous mammal species still occur in the north-west of South Australia. These are generally the small- (<40 g) and large-sized (>7.5 kg) species; a trend in keeping with results obtained in the arid zone in general (Morton & Baynes 1985, Burbidge & McKenzie 1987).

Morton & Baynes (1985) compared mammal assemblages of surface bone deposits with extant species in the western arid zone. They concluded that only 41% and 44% of the original polyprotodont marsupial and rodent faunas, respectively, remained today. Comparable figures of about 43% and 38% were obtained for the present study. Watts & Aslin (1981) compared recently (*i.e.* not fossil) extinct rodent species with those still extant and concluded that 25–60% remained.

More survey work is clearly needed to determine the distribution and status of extant species in the Pitjantjatjara lands. Particular emphasis should be placed on rare species such as the black-footed rock-wallaby *Petrogale lateralis*, the desert mouse *Pseudomys desertor*, and possibly the kultarr *Antechinomys laniger* and mulgara *Dasycercus cristicauda*. A comprehensive vegetation survey would aid in understanding the biology and distribution of extant forms as would a report on the status of non-indigenous species. We recommend that further survey work be of a multi-disciplinary nature and that predator scats and stomachs be investigated as a possible means of recording rare species.

Acknowledgments

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REVISION OF AUSTRALASIAN *STERNOLOPHUS* SOLIER (COLEOPTERA: HYDROPHILIDAE)

C. H. S. WATTS

WATTS, C.H.S. 1989. Revision of Australasian *Sternolophus* Solier (Coleoptera: Hydrophilidae). *Rec. S. Aust. Mus.* 23(2): 89-95.

The Australasian members of the hydrophilid genus *Sternolophus* Solier are revised and redescribed and a key to species is given. Three species are recognised: *S. australis* sp. nov., *S. immarginatus* d'Orchymont and *S. marginicollis* (Hope).

The following names are synonymised with *S. marginicollis* (Hope, 1842): *Hydrobius artensis* Montrouzier, 1860 and *Sternolophus tenebricosus* Blackburn, 1888.

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Among the most common of Australasian hydrophilids, especially in the warmer regions, are members of the genus *Sternolophus* Solier. At times in drying river bed pools it is possible to collect hundreds of individuals in a short time. Despite their abundance they have received little attention since d'Orchymont (1912).

Five Australian forms have been named. Of these I consider only two to represent valid species: *S. marginicollis* (Hope, 1842), and *S. immarginatus* d'Orchymont, 1912. I describe a further one, *S. australis* sp. nov. All occur broadly sympatrically across northern and inland Australia. They appear to be absent from the wetter coastal fringes of the south-west and the south-east and from Tasmania. *S. marginicollis* also occurs in New Guinea and New Caledonia. The genus itself consists of about a dozen species found in Africa, tropical Asia and Australasia.

I do not recognise the subgenus (or genus) *Neosternolophus* Zaitzev, 1909 used for the Australian and some African species (Knisch 1924, Smetana 1980), since I have found the main distinction, the extent of emargination of the clypeus, to vary even within species. A full study of all the species in the genus is required before the validity of the generic separation is established.

Systematics

The genus *Sternolophus* belongs to the subfamily Hydrophilinae, characterised by a continuous median longitudinal keel on the underside which is prolonged into a spine between the hind coxae. Within the Australasian members of this subfamily, *Sternolophus* is characterised by having the front of the ventral keel notched, the prosternal pillar not hooded to receive the front end of the ventral keel, the basal portions of all femora densely punctate-pubescent, and only four rows of serial punctures on each elytron *i.e.* lacking the fifth sublateral row of punctures present in most species of other genera. In most species the front margin of the clypeus has a central notch (Fig. 2).

Type species as follows: *Sternolophus*: *S. solieri* Castelnau, 1840, 'Africa'. *Neosternolophus*: *Hydrobius artensis* Montrouzier, 1860, Australia.

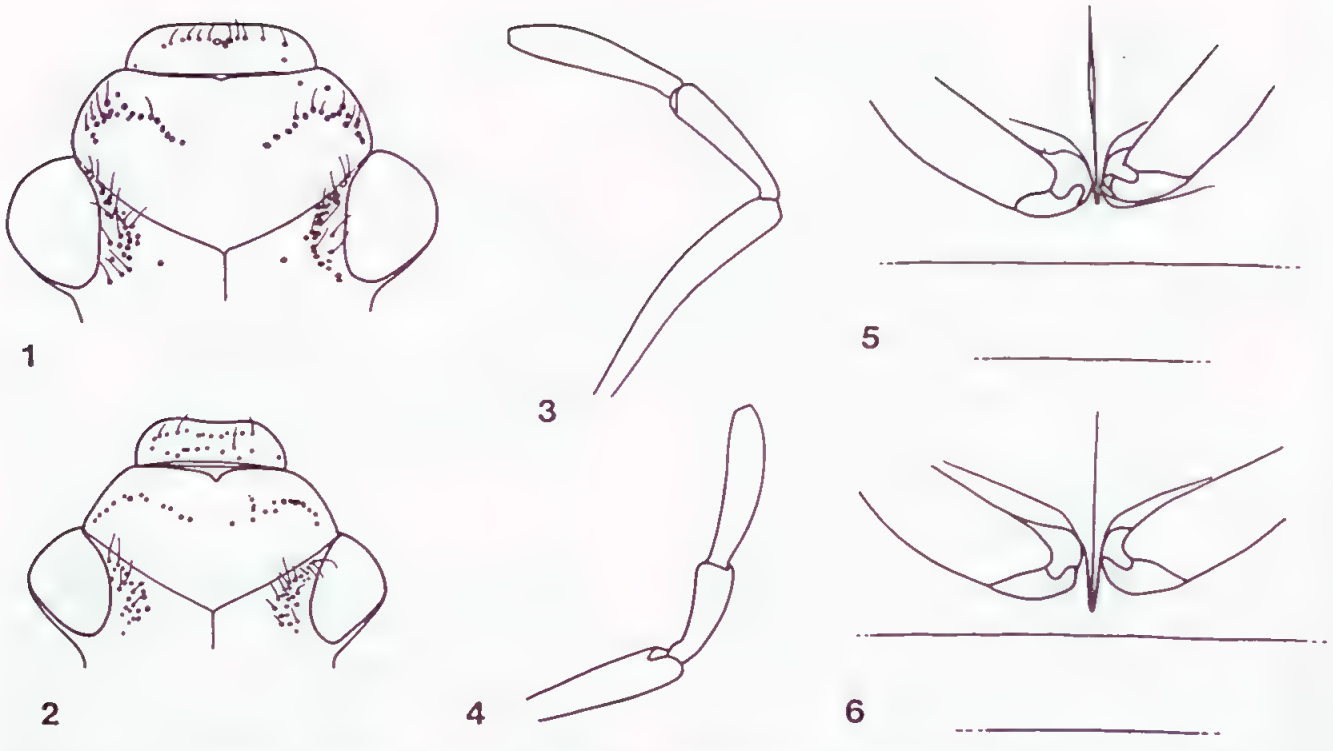
The collections from which specimens were examined are listed under the following abbreviations:

AM	Australian Museum, Sydney
ANIC	Australian National Insect Collection, Canberra
BMNH	British Museum (Natural History), London
CW	Private collection of author
RIB	Institut Royal des Sciences Naturelles de Belgique, Bruxelles
NMV	Museum of Victoria, Melbourne
NSWDA	New South Wales Department of Agriculture, Sydney
NTM	Museum and Art Galleries of the Northern Territory, Darwin
MNHP	Museum National d'Histoire Naturelle, Paris
SAMA	South Australian Museum, Adelaide
WAM	Western Australian Museum, Perth
QDPIM	Queensland Department of Primary Industries, Mareeba
QM	Queensland Museum, Brisbane.

Key To Australasian *Sternolophus*

1 — Sternal spine long, reaching to front edge of third abdominal sternite..... .....*rufipes* Fabricius*

— Sternal spine not reaching beyond first abdominal sternite.....2



FIGURES 1–6. 1, front of head of *S. australis*; 2, ditto, *S. marginicollis*; 3, labial palpus of *S. marginicollis*; 4, ditto, *S. australis*; 5, apex of sternal spine in *S. immarginatus*; 6, ditto, *S. marginicollis*.

2(1) — Maxillary palpi stout, same length as antennae, second segment noticeably shorter than apical (Fig. 4); row of punctures on outer face of protibia 9–10, largest at apex.....*australis* sp. nov.
— Maxillary palpi elongate, longer than antennae, second segment almost as long as apical (Fig. 3); more than 15 punctures in a row on outer face of protibia, largest towards base.....3

3(2) — Last abdominal sternite entire; sternal spine short, not reaching beyond metatrochanters (Fig. 5).....*immarginatus* d'Orchymont
— Last abdominal sternite notched at apex; sternal spine reaching to about middle of first abdominal sternite or beyond (Fig. 6) .....*marginicollis* (Hope)

*Not yet recorded from region but reaches Java.

Sternolophus australis sp. nov.

Description (number examined 82) (Figs 1, 4)

Length 11.5–14.5 mm. Oval, black. Head covered in small unevenly sized punctures evenly spread, stronger and denser along rear margin, a group of much larger punctures just inwards from eyes, and a semicircle of large punctures on frons forward from eyes, a few large punctures in line in middle of clypeus. Front margin of frons entire or only very weakly emarginate in centre. Pronotum covered in fine punctures as on head, each side with two slanting rows of much larger punctures inwards from edge and to about ⅓ width; sharply incised groove just inwards of lateral edge and along front edge to about level of inner margin of eye. Fine punctures on elytra weaker than on head, serial punctures much larger, well-marked, in four lines, punctures uneven in size and distribution, those in inner three striae generally in a single line, those in lateral series widely scattered particularly towards shoulder, a row of small punctures immediately inwards from lateral margin. Sternal carina thin, produced backwards in spine reaching a little way beyond hind coxal plates. Maxillary palpi a little shorter than antennae, stout, apical segment a little longer than penultimate, labial palpi stout, apical segment about half length of penultimate. Outer surface of protibia with row of 12–15 large seta-bearing punctures which, apart from some smaller ones close to knee, are even in size. Apical margin of last abdominal sternite complete.

Male

There is little difference between the sexes. The male has the claws on the front tarsi more sharply bent. Tips of parameres extend beyond tips of aedeagus.

Types

Holotype. M. 'Vaughan Springs, N.T. 4/68. C. Watts', in SAMA.

FIGURE 7. Distribution of *S. marginicollis*.

Paratypes. Same data as Holotype, 6 in SAMA, 15 in CW.

Distribution (Fig. 8)

NT — 19°58′S 129°39′E, ANIC; 13°02′S 133°05′E, QM; Alice Springs, SAMA; 30 miles W Alice Springs, CW; 38 km SSE Alice Springs, ANIC; Edith Falls, ANIC; Gove, NMV; Hart Range, NMV; John Hayes Rockhole E Mac. Rng., SAMA; Kakadu NP, CW; Koongarra, ANIC; 15 miles N Mt Cahill, ANIC; Palm Ck, NMV; Standley Chasm, CW, ANIC; Tallipatta Gorge, NMV.

WA — Carson Escarpment, ANIC; 50 miles S Giles, WAM; Gill Pinnacle, WAM; 10 miles W Halls Ck, WAM; Hammersley Range, WAM; 23 km N Millstream, SAMA; Mitchell Plateau, CW; Pincombe R., WAM; Synnott Rng., WAM; Upper Ord R., SAMA; Walsh Pt., CW; Walter James Rng., WAM; White Mountain, WAM. Wittenoon Gorge, WAM; 26 miles W Wittenoon, ANIC; Wotjulum, WAM.

QLD — Enasleigh R. *via* Mt Surprise, QDPIM; Kennedy Ck, QDPIM; Laura, QDPIM; Townsville, QM.

SA — Everard Rng., SAMA.

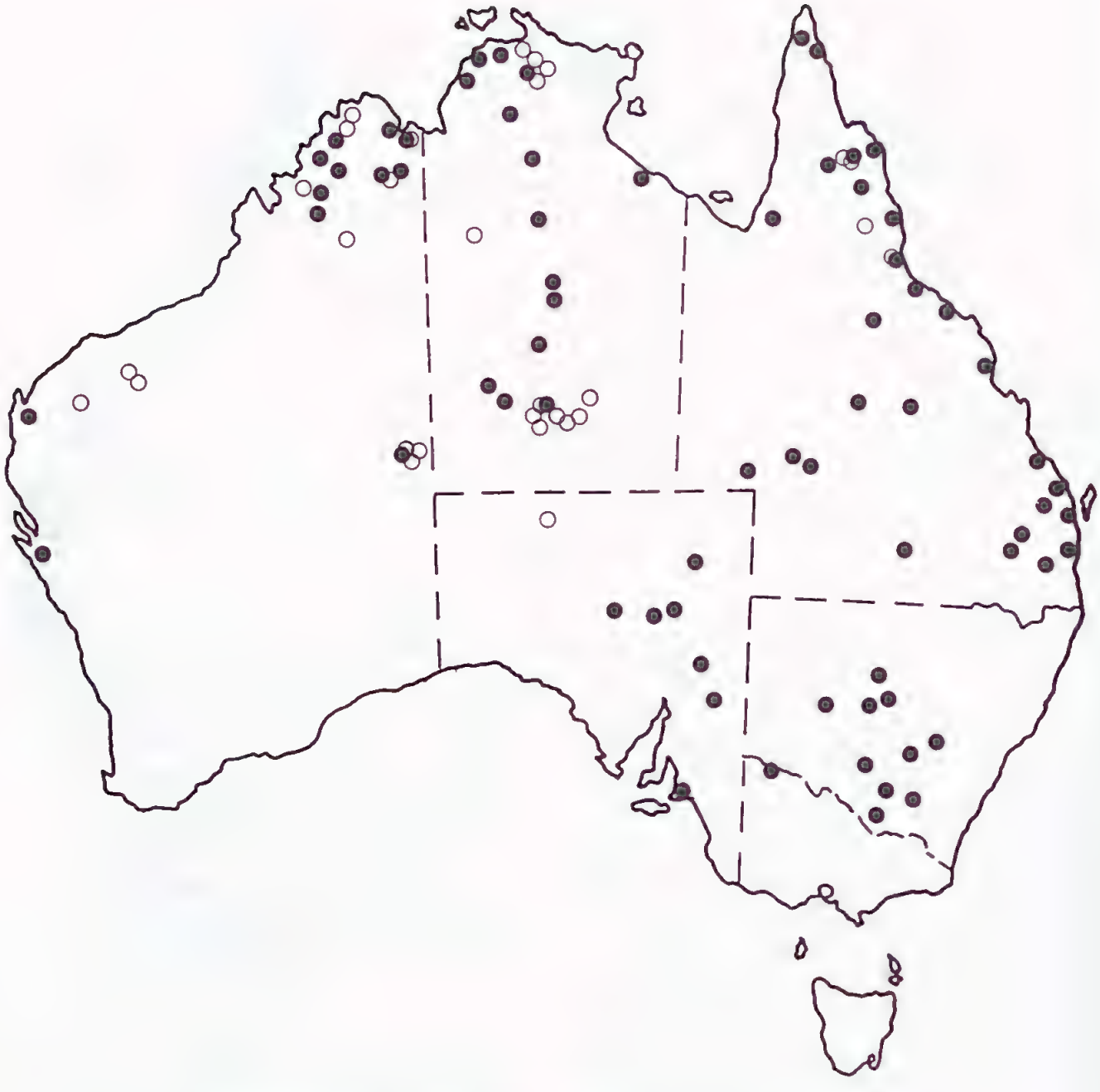


FIGURE 8. Distribution of *S. immarginatus* (●) and *S. australis* (○).

Sternolophus immarginatus d'Orchymont

Sternolophus immarginatus d'Orchymont, 1912, p. 56.
Sternolophus oceanicus Zaitzev, 1910, p. 225, syn. Knisch 1924, p.227.

Description (number examined 261) (Figs 4, 5)

Length 10.6–12.5 mm. Oval, black. Head covered in small but well-marked punctures of variable size, stronger and denser along rear margin, a patch of much larger seta-bearing punctures inward from eye and a ragged semicircle of some 12–15 similar punctures on frons forward of eye, a row of about 12 large seta-bearing punctures together with a scattering of similar punctures towards rear of clypeus. Front margin of frons emarginate showing yellow membrane beneath, central portion not, or only slightly, triangularly edentate. Punctures on pronotum as on head, a slanting straight line of single large seta-bearing punctures on side near middle and a similar, but curved, row near front margin on each side, well-marked groove along lateral edge extending in much weaker form across front margin. Elytral punctures as on pronotum but somewhat weakened, a row of small punctures along lateral margin with some scattered small elongate punctures inwards. Serial punctures weak, in four rows, punctures erratically placed, those in lateral rows widely scattered. Sternal carina narrow, spine short, blunt, reaching only to about margin of hind coxal plates, mesosternal keel relatively

short with a tuft of very long setae on front angle. Rugose portions on femora weakly restricted to very small area at base. Maxillary palpi elongate, larger than antennae, apical segment same length or slightly longer than penultimate, labial palpi elongate, apical segments slightly more than half length of penultimate. Outer surface of protibia with row of 20–30 seta-bearing punctures, those at base large, becoming progressively smaller towards apex. Apical margin of last abdominal segment complete.

Male

Claws on male protarsi more sharply bent than in female with large basal lobe. Tips of parameres and aedeagus level.

Types

Sternolophus immarginatus d'Orchymont. Holotype. M. 'Northern Territory S. (Neost.) immarginatus, Orch, Type, Dr d'Orchymont Det' in RIB. Seen.

Sternolophus oceanicus Zaitzev. Borneo. Type not located, synonymy after Knisch 1924, p. 227.

Distribution (Fig. 8)

QLD — Blackdown Tableland, QM; Brisbane, SAMA; Bundaberg, ANIC; Burnett R., ANIC; Cairns, ANIC, QM; Calliope R., ANIC; 12 km NNW Camerons Corner, ANIC; Carnarvon Rng., AM; Clermont R., ANIC; Cooktown, NMV; Cunnamulla, SAMA; Dalby, SAMA; Eidsvold, QM; Home Hill, CW; Ingham, ANIC QDPIM; Iron Rng., ANIC; 15 km WNW Johnstone R., QDPIM; Kowanyama, QM; Lake Broadwater *via* Dalby, QM; Laura, QDPIM; Lockyer Valley, SAMA; 31 km NNW Longreach, ANIC; Mackay, CW; Marina Plains, QDPIM; 7 miles S Marlborough NMV; Mary Ck, ANIC; 40 Mile Scrub, NQ, ANIC; Normanton, SAMA; Stewart Rng., SAMA; Townsville, ANIC, QDPIM; Windorah, ANIC; 55 km W by N Windorah, ANIC.

NT — 80 miles NW Alice Sp., CW; 11 km SW Borraloola, ANIC; Daly R., SAMA; Humpty Doo, ANIC, QDPIM; Katherine, NMV, ANIC; Mataranka, ANIC; Nabarlek Dam, SAMA; 17 miles NNE Newcastle Waters, ANIC; Barrow Ck., SAMA; Paton Valley, NMV; South Alligator R., NMV; Tennant Ck, NMV; 15 miles N Tennant Ck., ANIC; Tindal, ANIC; 50 miles N Vaughan Sp., CW; Yuendumu, CW.

NSW — 20 miles SSW Bourke, SAMA; Byrock, ANIC; 65 km W Cobar, NMV; Deniliquin, ANIC; Dubbo, AM; Geelagong, NMV; 37 km E Hay, SAMA; Mataranka, ANIC; Trangie, ANIC; Wilcannia, SAMA; Yass, NMV.

SA — Clayton Crossing, SAMA; Coopers Ck Crossing, SAMA; Deep Creek, SAMA; 20 miles N Koonamore Stn., L. Pinpa, SAMA; Lake Eyre, SAMA; Lake Frome, SAMA; Moomba, NMV; 15 km W Sturt Vale, SAMA.

VIC — Irymple, NMV.

WA — 16°40′S 125°29′E, WAM; Argyle Downs, WAM; Beverley Sp. Stn, WAM; Cane R. HS, ANIC; Drysdale R., ANIC; Fitzroy Crossing, ANIC; Gills Pinnacle, SAMA; Kalumburu, WAM; Kununurra, ANIC; Minilya R., ANIC; Ord River, WAM; Wyndham, ANIC.

Sternolophus marginicollis (Hope)

Hydrobius marginicollis Hope, 1842, p. 428.
Sternolophus marginicollis (Hope), Knisch 1924, p. 227.
Hydrobius assimilis Hope, 1842, p. 428, syn. Knisch 1924, p. 227.
Sternolophus nitidulus Macleay, 1871, p. 129; syn. Knisch 1924, p. 227; d'Orchymont, 1912, p. 56; Blackburn, 1888, p. 814.
Hydrobius artensis Montrouzier, 1860, p. 247, syn. nov.; Zaitzev, 1910, p. 225; d'Orchymont, 1912, p. 56.
Sternolophus tenebricosus Blackburn, 1888, p. 813; syn. nov.; Zaitzev, 1910, p. 225; d'Orchymont, 1912, p. 55; d'Orchymont, 1923, p. 420.

Description (number examined 390) (Figs 2, 3, 6)

Length 10.0–13.5 mm. Narrowly oval, black. Head evenly covered with small unevenly sized punctures strongly impressed, much larger and denser along rear margin, a group of large, seta-bearing punctures just inwards from eye, uneven semicircle of about 15 large seta-bearing punctures on frons forward from eyes, a row of about 15 similar punctures along rear of clypeus; front margin of frons emarginate exposing underlying membrane, central portion of margin more deeply incised in broad triangular shape. Pronotum covered in punctures similar to but a little smaller than those on head, each side with two slanting rows of large seta-bearing punctures, rows usually more than one row of punctures thick. Sharply incised groove adjacent to lateral margin and a weaker groove along front margin very weak or lacking in central portion. Elytron with scattered very small punctures, setose serial punctures, in four rows, distribution of punctures along rows uneven, those in inner three rows more or less in one line, those in lateral stria widely scattered particularly towards shoulder, a row of small punctures along extreme lateral margin of elytron with scattered elongate punctures of roughly the same size immediately inwards from them along elytron except humeral angle. Sternal carina quite stout for genus, particularly mesosternal portion, spine quite large reaching well beyond edge of coxal plate, reaching

nearly to second abdominal segment, and usually ending in sharp point. Outer surface of protibia with a row of 14–30 small seta-bearing punctures which tend to get smaller towards apex. Apical margin of last abdominal segment with small notch in middle.

Male

Claw on male protarsi more sharply bent than in female. Tips of parameres level with tip of aedeagus.

Types

Hydrobius marginicollis Hope. Port Essington. Holotype (by monotypy) in Hope Department of Entomology, University of Oxford. Seen.

Hydrobius assimilis Hope. Port Essington. Holotype (by monotypy) in Hope Department of Entomology, University of Oxford. Seen.

Hydrobius artensis Montrouzier. There are three specimens in Bedel's collection now in MNHP from New Caledonia labelled 'Hydrobius Artensis/ Montrouz Nlle Caled', one of which bears a 'type' label. I hereby designate the specimen bearing the 'type' label as lectotype. Seen.

Sternolophus nitidulus Macleay. Four syntype specimens in ANIC on permanent loan from MacLeay Museum labelled 'Gayndah'; 1 specimen in SAMA labelled 'Gayndah Queensland Masters' with a SAMA label in Lea's handwriting 'Sternolophus nitidulus MacL Queensland Cotype'; 2 specimens in AM labelled 'Holotype' which are presumably the two listed by McKeown (1948). I nominate the specimen labelled 'Sternolophus nitidulus McL.W. Burnett River' in AM as the lectotype and the other five specimens paralectotypes. Seen.

Sternolophus tenebricosus Blackburn. N. Territory. Holotype (by monotypy), collected by J.P. Tepper in SAMA. Seen.

Distribution (Fig. 7)

QLD — Ashgrove, QM; Ayr, ANIC; Babinda, AM, SAMA; Bamaga, QM; 20 km S Bloomfield, CW; Bribie I., ANIC; Brisbane, QM; Bundaberg, QM; Cairns, ANIC; Calliope R., ANIC; Cannonvale, ANIC; Canungra Ck, QM; Cape Flattery, QDPIM; Cape Tribulation, QM, QDPIM; 15 km W Captain Billy Ck, QM; 75 km S Cardstone, ANIC; Cardwell, ANIC; Charters Towers, CW; Clermont, AM; Coen, NMV; 40 km N Coen, CW; 60 km S Coen, CW; Cooktown, ANIC; Cooloola, QM; Daintree, QDPIM; Dalhunty R., CW, QM; 30 km W Fairview, QM; Flying Fish Pt., QM; 18 miles S Gympie, ANIC; Helenslea St., ANIC; Helenvale, CW; Hope Vale Mission, ANIC; Innisfail, ANIC; Iron Rng., ANIC; 15 km WNW S Johnston R., ANIC; Jundah, ANIC; 2 miles, 5 miles E Kamna, ANIC; Kennedy Ck S of Laura, QDPIM; Kingaroy, ANIC; Kirrama Rng., QM; Kowonyama, ANIC; Kuranda, ANIC, SAMA; 5 miles N Kuranda, ANIC; Lakeland Downs, CW; 12 km N Laura, CW; 70 km N Laura, ANIC; Little Laura R., QDPIM; 3 km E Lockerbie, QM; Malanda, CW; Mareeba, ANIC; 26 km E Mareeba, QM; Marina Plains, ANIC; Mary Ck, ANIC; McIlwraith Rng., QDPIM; 21 miles S Miriam Vale, ANIC; 2 miles W Mission Beach, ANIC; Moa I., QM; Mornington I., SAMA; Mossman, QDPIM, ANIC; 15 km NW Mossman, QM; Mt Cook Nt. Pk., ANIC; Mt Coolum, ANIC; Mt Finnigan, ANIC; Mt Moffat, QM; Mt Tambourine, QM; Mt Webb, ANIC; Musgrave, QM; Old Laura Stn., QDPIM; Peach Ck NQ, CW; Peachester, QM; 40 Mile Scrub, QDPIM; Shiptons Flat, ANIC; Silver Plains Hs, ANIC; Stannary Hills, ANIC; Stanthorpe, QM; Tolga, QDPIM; Townsville, NMV; Tully Falls, QM; Walkamin, ANIC; Yeppoon, AM, ANIC; 9 km SE Yeppoon, ANIC.

NT — 80 miles NW Alice Springs, CW; Bagot Ck, NMV; Berry Sp., ANIC; 45 km SW Borroloola, ANIC; Cape Crawford, ANIC; Daly R. Mission, ANIC; Darwin, CW, NMV; Ellery Ck, NMV; Glen Helen, NMV; Howard Sp., ANIC; Jim Jim Ck., ANIC, SAMA; Kambolgie Ck, CW; Mataranka, ANIC; McArthur R., ANIC; 19 km NEE Mt Cahill, ANIC; Mudginberry HS, ANIC; Nabarlek Dam, SAMA; 11 km SW Nimbuwah Rock, ANIC; Pine Ck, CW; Sth Alligator R., NMV; Tindal, ANIC; Vaughan Sp., CW; Wessel Isl., ANIC; Yuendumu, CW.

ACT — Black Mt, ANIC.

NSW — Brunswick Heads, ANIC; Bulla Bulla tank, CW; Coffs Harbour, ANIC; Corowa, ANIC; Deniliquin, NMV; Dorrigo, ANIC; Eccleston, AM; Gilgandra, CW; Kempsey, QM; Kempsey, SAMA; Mootwingee, ANIC; Orange, ANIC; Pilliga, ANIC; Queanbeyan, ANIC; Stephens Ck, SAMA; Urbenville, QM; Vallery, ANIC; 12 km N Woodenbong, QM.

VIC — Dimboola, ANIC; Echuca, NMV; Eskdale, NMV; Irymple, NMV; Kulkyne, CW; Little Desert, SAMA; Nagambie, ANIC;

WA — 24°20′S 116°50′E, WAM; 23 km WSW Barradale, ANIC; 17 km N Cane R. HS, ANIC; Eginbah, WAM; Kununurra, ANIC; Millstream, ANIC; 13 km NE Newman, ANIC; Toodyay, ANIC; Warburton Rg., SAMA; Warne R., WAM; Wotjulum, WAM.

SA — Coopers Ck Crossing, SAMA; Frome R., SAMA; 185 km S Radium Hill, SAMA; Renmark, ANIC; 24 km N Mt Serle, SAMA.

PNG — Amboin, ANIC; Bulolo, ANIC; Finsch Haven, SAMA; Goroka, ANIC; Mt Gyifrie, SAMA; Nemasado, CW; Pt Moresby, SAMA; Utai,

ANIC; NE Wau, ANIC; Wau, ANIC.
New Caledonia — Grotte de Ninnin-Rev, SAMA.

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HEMILEIUS (ACARIDA: CRYPTOSTIGMATA: SCHELORIBATIDAE) FROM SOUTH AUSTRALIAN SOILS

D. C. LEE

LEE, D. C. 1989. *Hemileius* (Acarida: Cryptostigmata: Scheloribatidae) from South Australian soils. *Rec. S. Aust. Mus.* 23(2): 97–111.

Hemileius Berlese, 1916 is rediagnosed and compared with other genera of Scheloribatidae. Three new species; *H. (H). biclavulus, H. (H.) copectus* and *H. (H.) rectus,* are grouped in the nominate subgenus. Two new species, *H. (T.) minimus* (type species) and *H. (T.) paratenuis*, are placed in a new subgenus, *Tenuileius*. These mites occurred most commonly in the litter and soil at the semi-arid, mallee-broombush and mallee-heath sites, but also at three others of the nine florally diverse South Australian sites studied. This is the first record of *Hemileius* from Australia. A key is given to distinguish the species described.

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This is a further part of an ongoing study of sarcoptiform mites in South Australian soils, sampled from nine florally diverse sites, and for which an introduction to the relevant work on the advanced oribate mites (Planofissurae) has been published (Lee 1987). *Hemileius* is grouped here in the Scheloribatidae Grandjean, 1933, although it is the nominotype of Hemileiidae Balogh & Balogh, 1984, a family without generally accepted validity and based on an arbitrary division in the character state series between the absence and presence of pteromorphs, which is also used in a questionable delineation of *Hemilieus* and *Scheloribates* (*see* under 'Remarks' on *Hemileius*). A new subgenus, *Tenuileius*, is established for species with a hysteronotal shield that is strongly tapered anteriorly, leaving the anterior two setae (*Z*1 and *Z*2) close to its lateral margin. The Scheloribatidae is considered further in a paper (Lee & Pajak in press) on this family, which particularly considers *Scheloribates* Berlese, 1908 and a new genus. The only other scheloribatid genus so far known from Australia is *Setobates* Balogh, 1962 (Lee & Pajak 1988).

Whilst all legs (femur–tarsus) have been illustrated in parts of this study, for *Hemileius* it has been considered sufficient to illustrate only leg II, except for one species (*H. rectus*). Measurements are in micrometres (μm). The mites examined were all collected by the author and are mainly deposited in the South Australian Museum (SAMA), but also in the Field Museum of Natural History, Chicago (FMNH) and the New Zealand Arthropod Collection, D.S.I.R., Auckland (NZAC).

Notation

The morphological notation is as that used for Scheloribatidae by Lee & Pajak (in press), but the following elaborations have been made to terms defining external somal ridges. A humeral tectum is distinguished from the larger pteromorph by its width being only subequal to or less than the diameter of the bothridium (base to seta *z*2). This is an arbitrary division of a character expressed as a continuous series of states through from no recognisable structure, an inconspicuous ridge, to a large wing-like flange or pteromorph. A ridge is considered *partial* if it extends only along part of the usual length covered. Ridges are *linear* if they form a narrow, superficial line; *costate* if they form a rib-like thickening; *laminar* if the thickening bears a flange. Ridge (or carina) *kf* (*see* Grandjean 1953, Fig. 2A) is here termed the *subtutorium*, a linear or costate proteropleural ridge level with acetabulum I. The subtutorium is not homologous with the tutorium since they can occur together as in *Muliercula ngoyensis* (Coetzer, 1968 Fig. 10), the tutorium running along part of a line between setae *j*1-*z*2. So far in this study no tutoria have been recognised.

Systematics

Genus **Hemileius** Berlese

Hemileius Berlese, 1916, p. 322. Type species (original designation): '*Protoribates (Scheloribates) initialis* Berl.' Grandjean, 1953, p. 119. Coetzer, 1968, p. 23. C. Pérez-Iñigo, 1984, p. 170.

Diagnosis

Scheloribatidae. Hysteronotum with 10 pairs of medium length or short setae (no microsetae). Pteromorph absent, humeral tectum may be present. Proteronotal setae *j*2–*j*2 separated by gap 1.25× or less distance *j*2–*z*1. Dorsosejugal furrow

complete and curved forward between lamellae, not straight. Femurs I and II with short stalk encompassed by collar and recess in caput so that pedestal and caput nearly abut. Tibiae without proximoventral cuticular spurs. Tarsus I usually with three (*av*1, *pv*1, *v*2) proximoventral setae, rarely v2 absent. Solenidia on tibiae III and IV taper distally (no microglobular tip). Pretarsus usually with three, rarely with two (central and anterior) claws, lateral claws without subterminal tooth and slimmer than central claw, but at least as stout as tarsal setae *d*4 at halfway along their length.

General morphology of Australian species

General appearance bulbiform or subrectangular with somal setae, except for proteronotal files *j* and *z*, fine and short, and legs short and stout or of medium-girth. Anterior margin of hysteronotal shield not obscuring aperture of bothridium to seta *z*2. Four pairs of normal (not fissuriform) sacculate hysteronotal foramina and smooth (without tubercles or longitudinal striae) integument. Proteronotal sensory seta (*z*2) capitate, lanceolate or fusiform, not setiform. Translamellar line (between *z*1–*z*1) absent. Prelamella (between setae *j*1–*z*1 or rostral margin–*z*1) costate or lineate, either may be partial. Lamella and sublamella weakly laminar, bothridium abuts onto lamella. Subtutorium straight or curved, linear or costate. Somal chaetotaxy: 2*j*, 2*z*, 1*s*; 2*J*, 6*Z*, 2*S*; 3*I*, 1*II*, 3*III* (rarely 2), 3*IV*; 4*JZg*, 1*Sg*; 2*JZa*, 3*Sa*; one lateral coxite seta (*III*3) may be microseta (*H. copectus*), note its absence on *H. (T.) tenuis*. Discidium rudimentary, either costate or flange height less than twice width of setal base *IV*3. Circumpedal ridge either absent or, if present, not reaching margin of opisthosternal shield. Mid-coxisternal groove present or absent. Leg chaetotaxy usually I — Tr 1, Fe 5, Ge 2 (1 *so*), Ti 4 (2 *so*), Ta 18 or 19 (2 *so*); II — Tr 1, Fe 5, Ge 2 (1 *so*), Ti 4 (1 *so*), Ta 15 (2 *so*); III — Tr 2, Fe 3, Ge 1 (1 *so*), Ti 3 (1 *so*), Ta 15; IV — Tr 1, Fe 2, Ge 2, Ti 3 (1 *so*), Ta 12. Variation on tarsus I because seta *v*2 present or absent. Order of diminishing leg length — I, IV, II, III; of diminishing maximum tibial height — I, II, IV, III (or III = IV). Flanges on femurs (even femur II) small or absent. Porose areas either present or absent on femurs and trochanters III and IV, but absent on tibiae and tarsi. Trochanter IV with caput length subequal to its height, curved dorsal surface so that subglobular in profile, crown forms a distoventral crescent-shaped flange sometimes weakly bilobed.

Remarks

Hemileius is very similar to *Scheloribates*, as suggested by Grandjean (1953), the major recognised difference being the presence or absence of a pteromorph. Despite this, Balogh & Balogh (1984) established the Hemileiidae, delineating it from the Scheloribatidae on the basis of this character. But the recognition of a pteromorph is subjective (Norton & Palacios-Vargas 1987), although artificially defined here (*see* under 'Notation'). The Hemileiidae is therefore to be synonymised (Lee & Pajak in press) with Scheloribatidae until a convincing delineating diagnosis is provided. It is also arguable that *Hemileius* should be regarded as a junior synonym of *Scheloribates*, because there is a strong similarity between *Hemileius rectus* sp. nov. and a small species of *Scheloribates* from the mallee-heath site (*see* Lee & Pajak in press) and *Hemileius initialis* (type species) is similar to some larger *Scheloribates* species.

In relation to other members of the Scheloribatidae, *Hemileius* is also superficially very similar to other members of the Hemileiinae Balogh & Balogh, 1984, as well as five genera (*Cryptozetes* Hammer, 1962; *Dometorina* Grandjean, 1951; *Metaleius* Travé, 1960, *Paraleius* Travé, 1960 and *Siculobata* Grandjean, 1953) overlooked by Balogh & Balogh (1984) in their review of the Oripodoidea (as 'Oribatuloidea'). Members of these five genera are adequately described, but their relationships are uncertain. *Cryptozetes, Dometorina* and *Siculobata* are principally epiphytic or saxicolous mites and their relationships are discussed by Norton & Palacios-Vargas (1987) in terms of specialisations, often regressive synapomorphies, for being epiphytic and derived from character states of edaphic genera such as *Hemileius*. It should be noted that whilst pteromorphs, pleural recesses delineated by circumpedal ridges or processes, and angular leg segment shapes are derived in the Oripodoidea, the loss of hysteronotal setae by *Hemileius* suggests that its lack of such character states may represent regressive synapomorphies, possibly for living in deeper soil layers, and sometimes it may also be saxicolous or epiphytic. The five species described here illustrate the problems of defining scheloribatid genera and diagnosing a genus such as *Hemileius*. They are smaller than the established species and also differ in lacking porose areas on the tibiae and tarsi. The species most superficially similar to the type species, *H. biclavulus*, differs in having only two pretarsal claws and it also lacks a proximoventral seta on tarsus I as for *Cryptozetes, Dometorina* and *Siculobata*. Another species, *H. rectus*, shows similarities to *Scheloribates*, whilst *H. copectus* is intermediate in form. Two species, *H. minimus* and *H. paratenuis*, are similar to the previously established *H. tenuis* Aoki, 1982, may represent a lineage adapted for deeper soil layers, and are referred to a new subgenus, *Tenuileius*. If there is

more confidence in the similarity between its members not reflecting convergence, then it might be better regarded as a genus. The formal diagnosis of *Hemileius* used by Coetzer (1968), that implied by the couplets in the keys of Balogh & Balogh (1984), as well as that provided here, may not indicate relationships.

To establish the number of known species in *Hemileius* is difficult. Initially the genus (as a subgenus of *Oribatula*) included eight species, of which one had a subspecies (as a variety), and for which the descriptions had limited value. Three of these species became the types of either *Dometorina, Siculobata* or *Liebstadia*, whilst the other four species have rarely been referred to since. Coetzer (1968) excluded four species from *Hemileius*, that had previously been in *Liebstadia* (multiporose rather than sacculate foramina) or *Scheloribates* (pteromorph present). Of the seven species newly combined with *Hemileius* by Coetzer (1968), C. Pérez-Iñigo (1984) excluded one and suggested that the other six, as well as the four rarely referred to species grouped in *Hemileius* when it was established, should probably also be excluded. The 15 species grouped here in *Hemileius* are listed under the two subgenera.

Key to South Australian *Hemileius* Species (Adults)

1 — Setal distance *z*2–*Z*1 0.8× or less distance *z*2–*j*2. Hysteronotal humeral margin convex with tectum. If pedotectum II extends laterally further than I, then humeral tectum extends further still..... .....*Hemileius (Hemileius)* Berlese, 2.

— Setal distance *z*2–*Z*1 subequal to distance *z*2–*j*2. Hysteronotal humeral margin concave, without humeral tectum. Pedotectum extends laterally further than I..... ....*Hemileius (Tenuileius)* subgen. nov., 4.

2 — Interlamellar seta (*j*2) medium-length, able to reach *z*1. Setal distance *1*1–*1*1 about 2× distance *11*1–*11*1. Short midsternal apodeme level with setae *11*1 and *111*1..... .....*H. (Hemileius) copectus* sp. nov.

— Interlamellar seta (*j*2) long, able to reach *j*1. Setal distance *1*1–*1*1 subequal to distance *11*1–*11*1. No midsternal apodeme.....3

3 — Pretarsi with two claws. Humeral tectum width about 0.3× diameter of bothridium (base to seta *z*2). Hysterosoma bulbiform. Pedotectum II not extended laterally as far as I..... .....*H. (Hemileius) biclavulus* sp. nov.

— Pretarsi with three claws. Humeral tectum width subequal to diameter of bothridium (base to seta *z*2). Hysterosoma parallel-sided. Pedotectum II extends laterally further than I .....*H. (Hemileius) rectus* sp. nov.

4 — Sensory seta *z*2 caput subglobose. Subtutorium extends forward to near seta *z*1. Hysteronotal shield very narrow, seta *Z*2 as close to margin as diameter of its base. Gap between genital orifice and anterior sternal margin 1.5× or more distance between genital and anal orifice..... .....*H. (Tenuileius) minimus* sp. nov.

— Sensory seta *z*2 caput fusiform. Subtutorium not extended forward to near seta *z*1. Hysteronotal shield narrow, seta *Z*2 more than 0.5× its length away from margin. Gap between genital orifice and anterior sternal margin less than 1.5× distance between genital and anal orifice..... .....*H. (Tenuileius) paratenuis* sp. nov.

Subgenus **Hemileius (Hemileius)** Berlese

Diagnosis

Hemileius. Hysteronotal seta *Z*1 near to anterior margin of hysteronotal shield (distance *z*2–*Z*1 0.8× or less distance *z*2–*j*2). Hysteronotal shield wide with convex humeral tectum dorsally obscuring pleural striated cuticle and leaving seta *Z*2 more than its length away from margin. Pedotectum II usually not extending laterally further than I; if it does, then humeral tectum extends further still.

General morphology of Australian species

Colour shiny brown or yellowish-brown. Smaller than established species (247–447 compared to 450–710). Legs short (mean femur–tarsus length: 36–40% of somal length) and tibiae medium-girth to stout (mean maximum height: 38–49% of mean length). Humeral tectum and limbus widths between 0.3× and subequal to diameter of bothridium, but not correlated (e.g. *H. biclavulus* with inconspicuous humeral tectum and broad limbus), limbus encompassing entire hysteronotum behind humeral tectum. Sacculate foramina with slit-shaped or round pores.

Distribution

Although some species from the Southern Hemisphere have been grouped in *Hemileius*, previously established species currently in this genus all appear to be known only from the Northern Hemisphere. Records and species numbers are greatest from southern parts of northern temperate regions, either around the Mediterranean and Canary Islands (Pm) or in the United States of America (Nr, Na) and Hawaii (Ap). Records from further north (Pe, Nn) are limited to *Hemilieus initialis* in Europe and to *H. quadripilis* and an unidentified species in Canada (Marshall, Reeves & Norton 1987).

The three new species of *Hemileius (Hemileius)* from South Australia appear to be the only Southern Hemisphere records. Two species occur in large enough numbers at relatively dry semi-arid, mallee-broombush and mallee-heath sites to support their ecological categorisation as hemiedaphic or, in the case of the smaller species, as possibly being euedaphic. The other species, *Hemileius copectus*, is mainly found (32 adults) at the semi-arid site, but is also represented by a single specimen at both sclerophyll forest and pine forest sites, suggesting that an edaphic species at a drier site may be saxicolous or epiphytic at the moister sites and so poorly represented in soil and litter samples.

Remarks

Hemileius (Hemileius), the nominate subgenus, includes a heterogeneous majority of species in the genus. It ranges in form from the type, which is somewhat like *H. biclavulus* and has similarities to the epiphytic *Dometorina* for example, to *H. rectus* with similarities to some *Scheloribates*.

The following 12 species are grouped in *Hemileius (Hemileius)*: *H. (H.) biclavulus* sp. nov.; *H. (H.) comatus* Berlese, 1920; *H. (H.) copectus* sp. nov.; *H. (H.) elongatus* E. Pérez-Iñigo, 1978; *H. (H.) gressitti* Balogh & Balogh, 1983; *H. (H.) haydeni* (Higgins & Woolley, 1975); *H. (H.) hierrensis* C. Pérez-Iñigo, 1984; *H. (H.) initialis* (Berlese, 1908), type species; *H. (H.) nicki* Denmark & Woodring, 1965; *H. (H.) quadripilis* Fitch, 1856 (syn. *pallida* Ewing, 1909); *H. (H.) rectus* sp. nov.; *H. (H.) robustus* C. Pérez-Iñigo, 1969.

The generic placement of *H. (H.) quadripilis* is problematic (*see* Marshall, Reeves & Norton 1987), but its synonymy with *H. (H.) pallida* Ewing, 1909 is accepted, although *H. (H.) pallida* Ewing: Hammer, 1952 from Canada (Nn) may not be conspecific with it, having substantially shorter hysteronotal setae.

Hemileius (Hemileius) biclavulus sp. nov.
Figs 1, 2 and 8

Female

Dorsal profile usually bulbiform, sometimes more parallel-sided than illustrated (Fig. 1). Idiosomal length, 404 (25, 380–447). Leg lengths (femur-tarsus for idiosomal length 411): I — 198, II — 161, III — 136, IV — 163. Tibial maximum heights (for 411): I — 23, II — 18, III — 15, IV — 15.

Proteronotum with incomplete prelamella extending from seta *j*1 only halfway towards *z*1. Lamella and sublamella costate, sublamella less robust, runs close to lamella along anterior half, bothridium (base *z*2) closer to lamella. Subtutorium linear and straight, with alveolate sculpturing posterior and ventral to it. Setae *j*1, *j*2, *z*1 inconspicuously ciliate, interlamellar (*j*2) and lamellar (*z*1) setae long, *j*2 reaching to level of *j*1, and *z*1 reaching beyond rostral apex. Sensory seta (*z*2) long, reaching *z*1; exposed stalk slightly longer than caput (appears shorter in Fig. 1 because sloping dorsalwards); caput fusiform, three files of cilia, maximum of seven cilia in any file, parallel-sided when viewed dorsally (Fig. 1), uniconvex viewed laterally. Seta *s*2 length about twice diameter of bothridial aperture.

Hysteronotal setae subequal in length, but *J*6, *Z*6, *S*6 slightly longer. Humeral tectum small but limbus substantial, width about ×0.3 and subequal to diameter of bothridium respectively. Two pairs of unnamed pores (usually anterior pair between seta *Z*2–foramen *F*3, posterior pair between seta *S*5–midline; rarely anterior pair between foramen *F*3–midline or third pair between *Z*4–midline). Slit-like pore *hf*3 short, approximately transverse; *hf*4 and *hf*5 parallel to lateral margin, visible ventrally (not illustrated in Fig. 2, too near margin), *hf*6 oblique, adaxial end posterior. Sacculate foramina with slit-shaped pores.

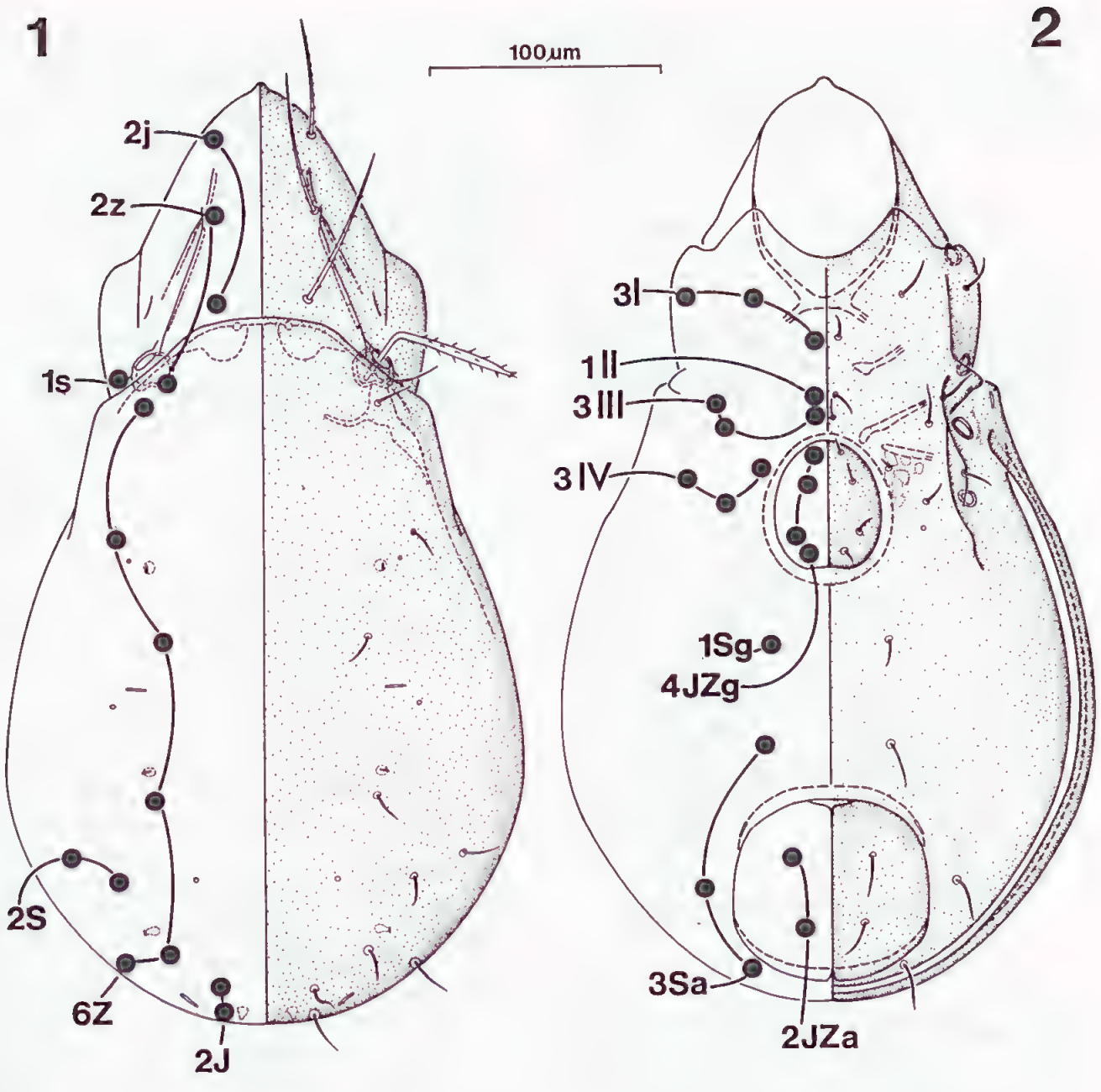
Podosternum with medium gap (about 0.66× setal distance *1*1–*1*1) between apodemes I. Adaxial end of apodeme III base latitudinally level with genital seta *JZ*1 and longitudinally level with coxite seta *1V*1. Custodial ridge present. Discidium forms shallow flap (depth about twice diameter of setal base *1V*3). Circumpedal ridge reaching forward to merge with discidial ridge and backward so that half of its length lies posterior to aperture to acetabular cavity IV. Alveolate sculpturing along midcoxite region (Fig. 2, illustrated only on coxite IV). No midsternal apodeme. Lateral coxite setae longer than those around genital shield.

Opisthosternum with genital setae less than half length of anal setae. Eggs subcylindrical, 189 × 85 (2 eggs, 47% of somal length 401), rugose exochorion. Number of eggs in female (number of females) as follows: none (12), one (3), two (12), three (9), four (4).

Legs short (mean femur-tarsus length: 40% of soma). Dorsal porose area on all femurs and trochanters III and IV. Rugae posteriorly on femurs III and IV. Shallow ventral flanges on keels of femurs II, III and IV. Solenidium *so*1 on tarsus I subequal in diameter to base of seta *d*3, and reaching setae *d*4. Only five ventral setae on tarsus I, proximoventral seta *v*2 absent, proximal three with 8 to 10 cilia (longest cilium longer than setal base diameter). Pretarsi with two claws (anterior slim and central stout claw).

Male

As female, except proteronotal setae in files *j* and



FIGURES 1 AND 2. *Hemileius (Hemileius) biclavulus* sp. nov., female soma. 1, notum; 2, idiosternum.

z may be slightly longer. Soma smaller, idiosomal length 367 (mallee-heath, 25, 339–373) and 362 (mallee-broombush, 1).

Material examined

Holotype: ♀(N198887), sand, litter, under banksia shrubs (*Banksia ornata*), Tamboore Homestead (35°57′S, 140°29′E), 4.viii.1974.

Paratypes: 27♀♀ (N198888–N1988114), 72♂♂ (N1988115–N1988186), same data as holotype; 2♀♀, 2♂♂ — FMNH; 2♀♀, 2♂♂ — NZAC.

Undesignated: 120♀♀, 309♂♂, same data as holotype. Single ♂ (N1988187), sand, litter, sparse moss, under ridge-fruited mallee (*Eucalyptus incrassata*) amongst broombush shrubs (*Melaleuca uncinata*), Ferries-McDonald Reserve (35°15′S, 139°09′E), 20.vi.1974.

Distribution

Australia (Aa). South Australia. Mallee-broombush, open scrubland (Ferries-McDonald Reserve), Murray-Darling basin, 1♂/1 of 8× 25 cm². Mallee-heath, tall open shrubland (Tamboore Homestead, near Mt Rescue Conservation Park), Murray-Darling basin, 148♀♀, 381♂♂/8 of 8 x 25 cm².

Remarks

H. biclavulus is the largest South Australian species of *Hemileius* with similar facies to the slightly bigger type species, *H. initialis*. On the other hand, *H. biclavulus* is unique in the subgenus in having only two pretarsal claws and five ventral setae on tarsus I (a reduced ventral setation on

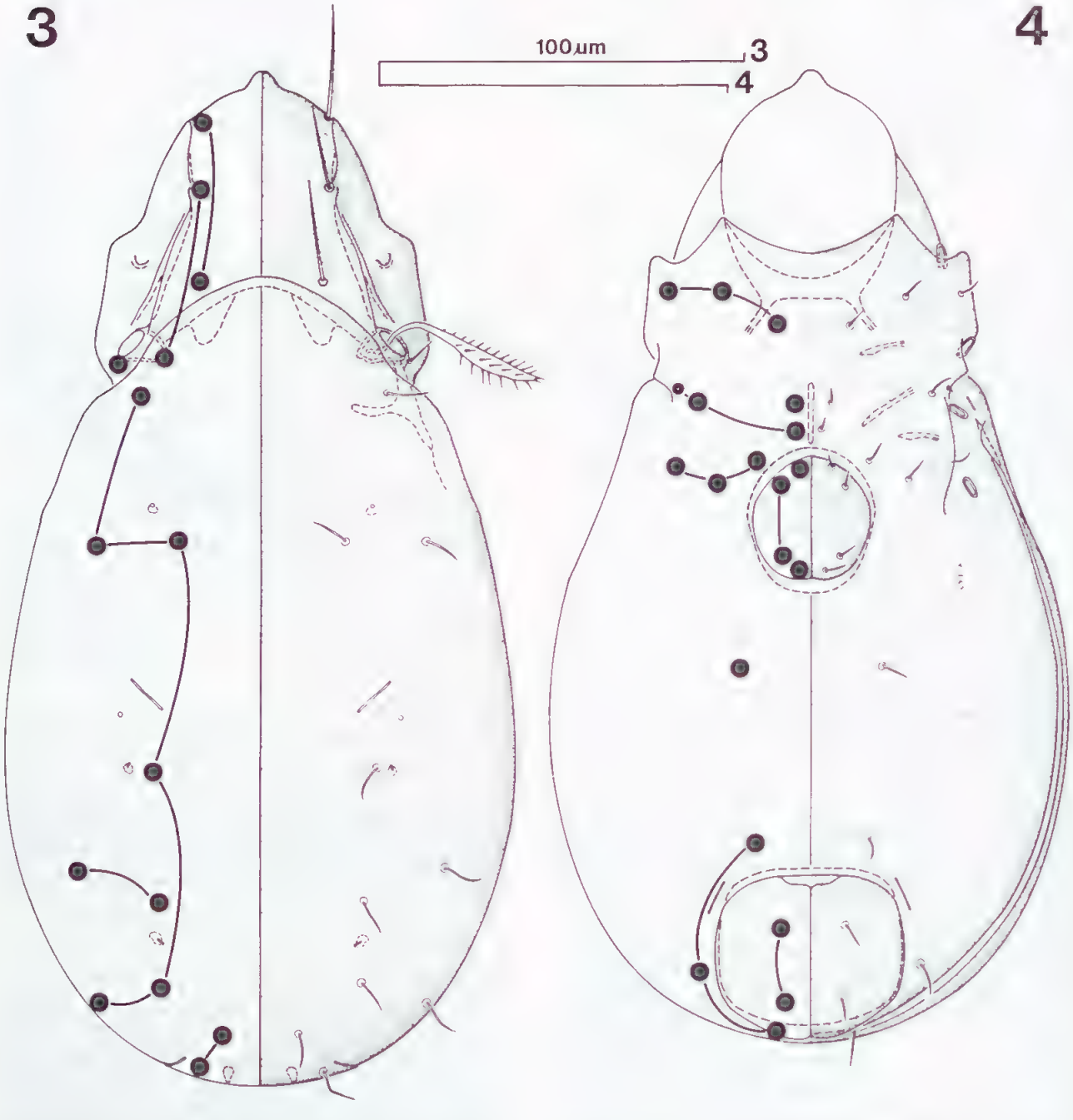
tarsus I is also recorded for the epiphytic *Cryptozetes, Dometorina* and *Siculobata*). Although given a minor weighting here, these two characters have been used to diagnose oripodoid genera.

Hemileius (Hemileius) copectus sp. nov.
Figs 3, 4 and 9

Female

Dorsal profile ovoid. Idiosomal length, 278 (semi-arid shrubland, 10, 262–288) and 270 (sclerophyll forest, 1). Leg lengths (femur–tarsus for idiosomal length 276, semi-arid shrubland): I — 123, II — 108, III — 95, IV — 111. Tibial maximum heights (for 276): I — 15, II — 13, III — 12, IV — 12.

Proteronotum with complete prelamella (seta *j*1-*z*1-rostral margin), costate near *j*1, rest linear. Lamella laminar, sublamella costate, runs close to lamella along anterior half (may appear more robust from some angles because more refractile), bothridium (base of seta *z*2) closer to lamella. Subtutorium semicircular, linear. Setae *j*1, *j*2, *z*1 inconspicuously ciliate, interlamellar (*j*2) and lamellar (*z*1) setae medium-length; *j*2 reaching *z*1, *z*1 reaching *j*1. Sensory seta (*z*2) long, reaching *z*1; exposed stalk slightly shorter than caput (appears even shorter in Fig. 4 because sloping dorsalwards); caput fusiform, three files of cilia, anterior file on



FIGURES 3 AND 4. *Hemileius (Hemileius) copectus* sp. nov., female soma. 3, notum; 4, idiosternum.

straight margin with 14–16 cilia along caput and stalk, other files with 6–8 cilia confined to caput. Seta *s*2 length subequal to diameter of bothridial aperture.

Hysteronotal setae subequal in length, but *J*6, *Z*6, *S*6 slightly larger. Humeral tectum and limbus small, width of both ×0.3 diameter of bothridium. Unnamed pores not located. Slit-like pore *hf*3 oblique, adaxial end posterior, *hf*4 and *hf*5 parallel to lateral margin, visible ventrally (not illustrated in Fig. 4, too near margin), *hf*6 oblique, adaxial end anterior Sacculate foramen *F*3 with round pore, whilst *F*4, *F*5, *F*6 with slit-shaped pores.

Podosternum with wide gap (subequal to *I*1–*III*1) between apodemes I. Adaxial end of apodeme III base latitudinally level with coxite seta *III*1 and on longitudinal line closer to coxite seta *IV*2 than *IV*1. Midsternal apodeme between setal pairs *II*1 and *III*1. No custodial ridge. Discidial ridge without discidium. No circumpedal ridge. Pedotectum II short, not extending as far laterally as pedotectum I. No midcoxite sculpturing or midsternal apodeme. Coxite setae all short, *II*1 and *III*1 particularly short, seta *III*3 inconspicuous microseta.

Opisthosternum with genital setae more than half length of anal setae, but adanal setae *Sa*2, *Sa*3 longer. Eggs subcylindrical, 157 × 82 (1 egg, 55% of somal length 285), granulate exochorion. Number of eggs in female (number of females) as follows: none (9), one (3).

Legs short (mean femur–tarsus length: 40 % of soma). Indistinct porose area on femurs and trochanters III and IV. Indistinct rugae on femurs III and IV. No ventral flanges on keels (not discernible from lateral aspect) of femurs II, III, IV. Solenidion *so*1 on tarsus I subequal in diameter to base of setae *d*3, and reaching setae *d*4. Six ventral setae on tarsus I, proximoventral seta *v*2 present, proximal four with three or four cilia (longest cilium longer than setal base diameter). Pretarsi with three claws (central stout claw, lateral slim claws).

Male

As female, except soma smaller, idiosomal length, 259 (semi-arid shrubland, 18, 252–271) and 262 (pine forest, 1).

Material examined

Holotype: ♀ (N1988188); soil, litter, moss and other low growth plants under bladder saltbush (*Atriplex vesicaria*) amongst sparse false sandalwood (*Myoporum platycarpum*), Koonamore Vegetation Reserve (32°07′S, 139°21′E), 27.vi.1974.

Paratypes: 9♀♀ (N1988189–N1988197), 18♂♂ (N1988198–N1988215), same data as holotype.

Undesignated: 2♀♀ and 2♂♂ lost, same data as holotype. Single ♀ (N1988216), soil, litter, sparse moss, under sclerophyllous shrubs amongst messmate stringybark (*Eucalyptus obliqua*), nr summit of Mt Lofty, Cleland Conservation Park, 34°59′S, 138°45′E, 9.v.1974. Single ♂ (N1988217), soil, litter, under *Pinus pinea*, Kuitpo Forest Reserve (35°12′S, 138°41′E), 22.v.1974.

Distribution

Australia (Aa), South Australia. Semi-arid low shrubland (Koonamore Vegetation Reserve), Lake Eyre Basin, 12♀♀, 20♂♂/6 of 8 × 25 cm². Sclerophyll forest (Mt Lofty, Cleland Conservation Park), South gulfs, ♀/1 of 8 × 25 cm². Cultivated pine forest (Kuitpo Forest Reserve), South gulfs, ♂/1 of 8 × 25 cm².

Remarks

H. copectus is distinguishable from non-Australian species in the nominate subgenus by its small size and only medium-size proteronotal setae *z*1 and *j*2. It is similarly distinguishable from *H. biclavulus*, whilst *H. rectus*, which is of a similar size, has long proteronotal setae and a more substantial humeral tectum. Ventrally, coxite seta *III*3 is reduced to a microseta, drawn slightly larger in illustration (Fig. 4) so that it is recognisable, and there is a short midventral apodeme anterior to the genital shield, both unique character states for the genus.

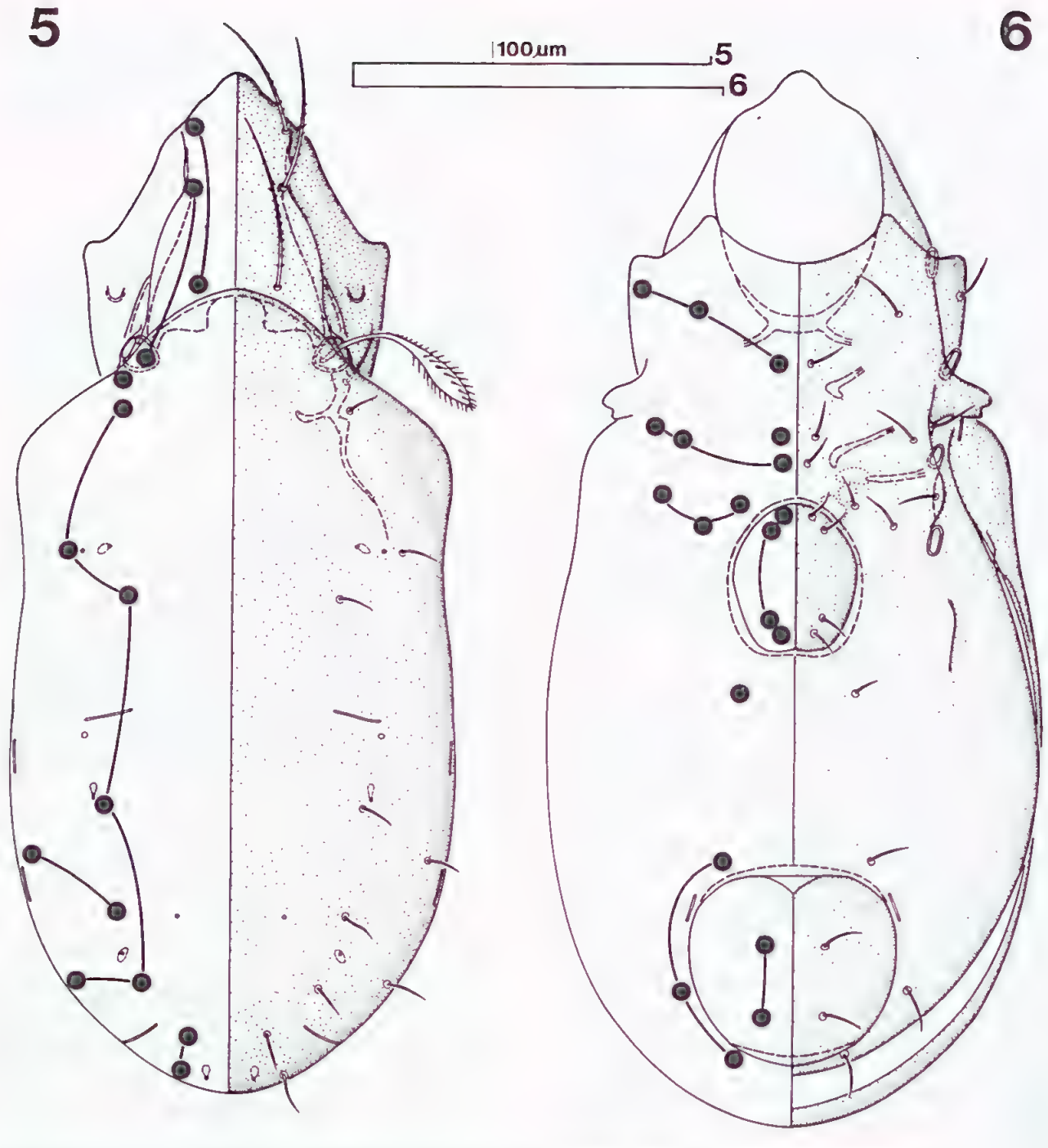
Hemileius (Hemileius) rectus sp. nov.
Figs 5–7

Female

Dorsal hysteronotal profile subrectangular, partly due to humeral tecta. Idiosomal length, 280 (25, 260–300). Leg lengths (femur–tarsus for idiosomal length 293): I — 121, II — 105, III — 85, IV — 113. Tibial maximum heights (for 293): I — 18, II — 15, III — 13, IV — 14.

Proteronotum with complete prelamella (seta *j*1–*z*1), costate near *j*1, rest linear. Lamella mainly laminar, costate near *z*2. Sublamella costate, runs close to lamella along anterior half, bothridium (base seta *z*2) closer to lamella. Setae *j*1, *j*2, *z*1 inconspicuously ciliate, interlamellar (*j*2) and lamellar (*z*1) setae long; *j*2 reaching level of *j*1, *z*1 reaching beyond rostral apex. Sensory seta (*z*2) medium-length, reaching beyond *j*2; exposed stalk shorter than caput; caput fusiform, three files of cilia, anterior file with 16–18 cilia along caput and stalk, medium file with 8–9 cilia and posterior file with 11–13 cilia confined to caput. Seta *s*2 length about 1.5× diameter of bothridial aperture.

Hysteronotal setae subequal in length, but *J*6 and *Z*6 slightly longer. Humeral tectum conspicuous, width about 0.25× distance *Z*1–*Z*2; limbus small,



FIGURES 5 AND 6. *Hemileius (Hemileius) rectus* sp. nov., female soma. 5, notum; 6, idiosternum.

width about 0.1× distance *Z*1–*Z*2. Unnamed circular pores present between and near setae *Z*2 and *S*4. Slit-like pore *hf*3 oblique, with adaxial end anterior, sometimes transverse, rarely adaxial end posterior (one side only), *hf*4 and *hf*5 visible dorsally (Fig. 5), *hf*6 oblique with adaxial end anterior. Sacculate foramina with round pores.

Podosternum with medium gap (about two thirds *I*1–*III*1) between apodemes I. Adaxial end of apodeme III base latitudinally level with point anterior to genital shield and longitudinally level with point closer to coxite seta *IV*1 than *IV*2. Custodial ridge present. Discidium forms a shallow flap (depth about twice diameter of setal base *IV*3). Short straight circumpedal ridge separate and well behind other subpodal ridges. Weak alveolate sculpturing along mid-coxite region (Fig. 6, illustrated only on coxite IV). No midsternal apodeme. Pedotectum II robust, long, extending further laterally than pedotectum I. Lateral coxite setae longer than those around genital shield.

Opisthosternum with genital setae about two-thirds length of anal setae. One female with 6*JZg* on one side (extra seta halfway between *JZg*2–*JZg*3).

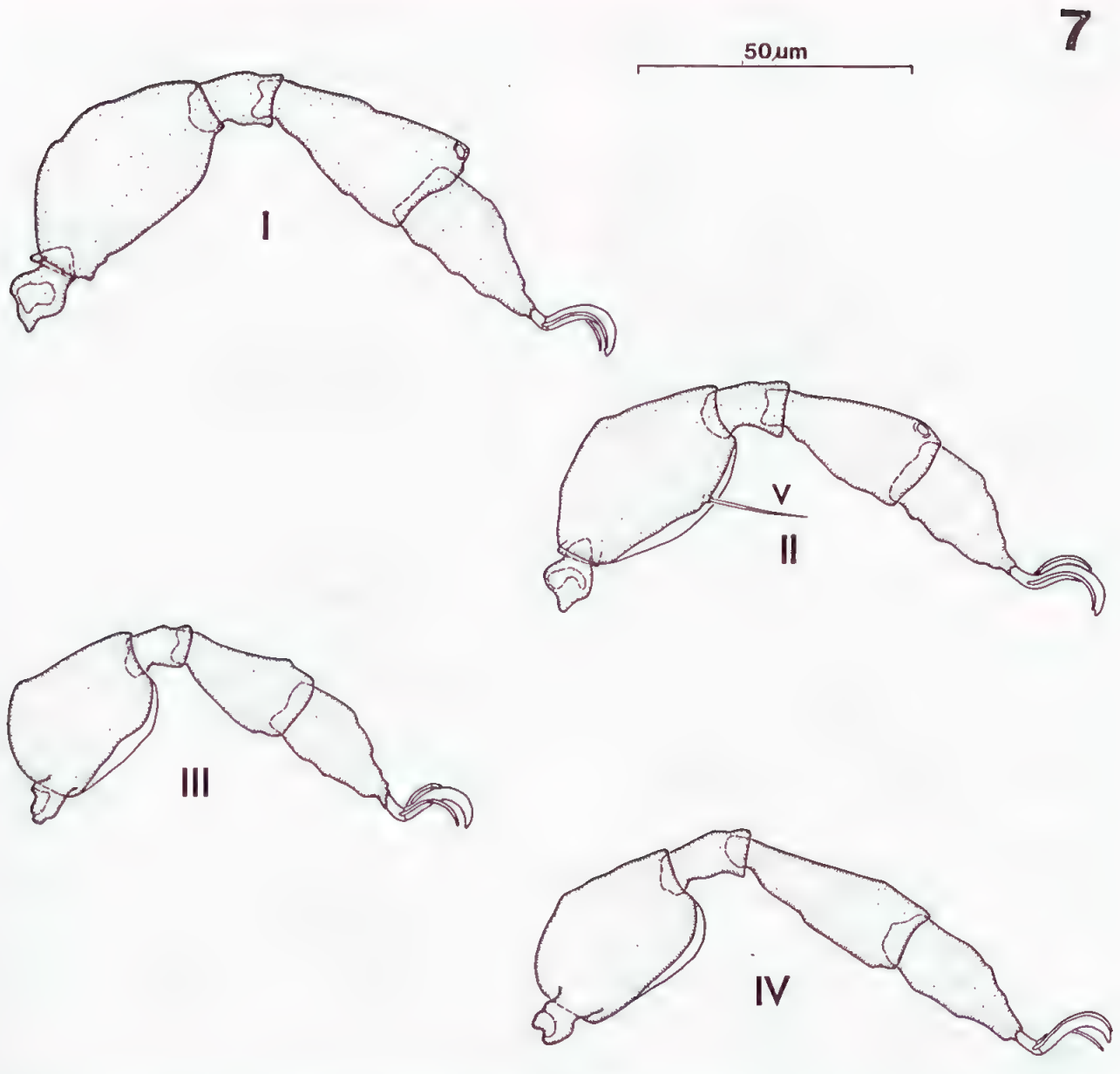


FIGURE 7. *Hemileius (Hemileius) rectus* sp. nov., posterior aspect to femur–pretarsus of right legs showing only one seta.

Eggs oval, 139 × 80 (1 egg, 50% of somal length 278), granular exochorion. Number of eggs in female (number of females) as follows: none (30), one (36), two (5).

Legs short (mean femur–tarsus length: 36% of soma). Porose areas on femurs and trochanters III and IV. Indistinct or no rugae on femurs I and II, distinct rugae on femurs III and IV. Shallow ventral flanges on femurs II, III, IV. Solenidium *so*1 on tarsus I subequal in diameter to base of seta *d*3 and reaching setae *d*4. Ventral setae on tarsus I with six or seven cilia (longest cilium subequal in length to seta base diameter) along two thirds of length. Six ventral setae on tarsus I, proximoventral seta *v*2 present, all of them with 8 or 10 cilia, longest subequal to setal base in diameter. Pretarsi with three claws (central stout claw, lateral slim claws).

Male

As female, except smaller soma, idiosomal length 247 (25, 226–265).

Material examined

Holotype: ♀ (N1988218); soil, litter and sparse moss under ridge-fruited mallee (*Eucalyptus incrassata*) clumps amongst broombush shrubs (*Melaleuca uncinata*), Ferries–McDonald Conservation Park (35°15′S, 139°09′E), 20.vi.1974.

Paratypes: 66♀♀ (N1988219–N1988277 and N1989148–N1989154), 40♂♂ (N1988278–N1988311 and N1989155–N1989160), same data as holotype; 2♀♀, 2♂♂ — FMNH; 2♀♀, 2♂♂ — NZAC.

Distribution

Australia (Aa). South Australia. Mallee-

broombush, open scrubland (Ferries-McDonald Reserve), Murray-Darling basin, 71 ♀ ♀, 44 ♂ ♂/7 of 8 × 25 cm².

Remarks

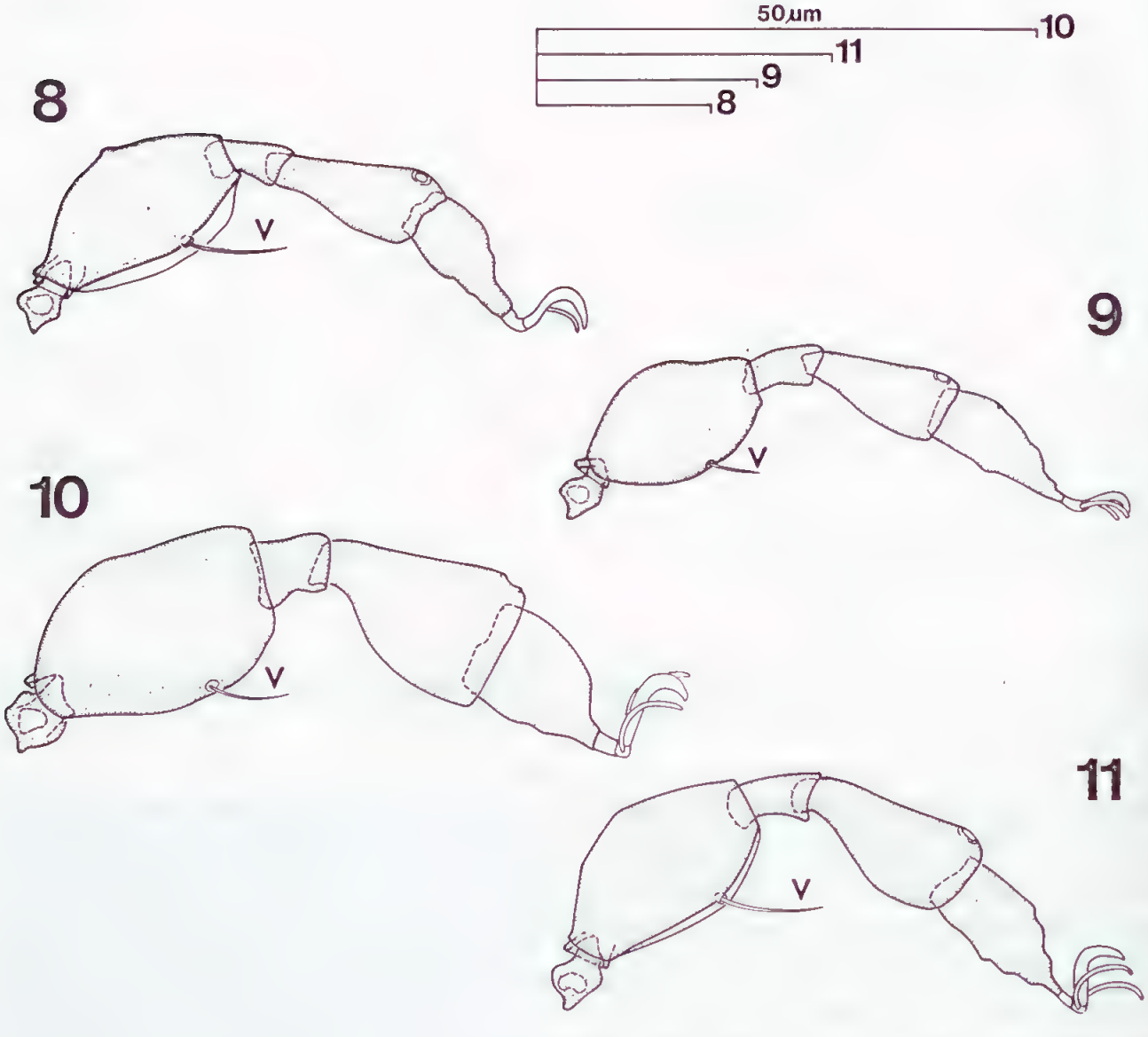
H. rectus is distinguishable from non-Australian species in the nominate subgenus by its smaller size. It has the largest humeral tectum for the genus, which, with the parallel-sided hysteronotum and long interlamellar and lamellar setae, makes it appear similar to some small species of *Scheloribates*. But the humeral tectum in lateral view is substantially smaller than the pteromorphs of *Scheloribates* as is the ventral flange on femur II, although the similarities may reflect a close relationship.

Subgenus **Hemileius (Tenuileius)** subgen. nov.

Type species: *Hemileius (Tenuileius) minimus* sp. nov.

Diagnosis

Hemileius. Hysteronotal seta *Z*1 distant from anterior margin of hysteronotal shield (distance *z*2–*Z*1 subequal to *z*2–*j*2). Hysteronotal shield narrow anteriorly with humeral margin strongly tapered, linear and without tectum, so that seta *Z*2 less than its length from margin. Striated cuticle that separates hysteronotum from ventral shields clearly visible from above, reaching as far forward as seta *z*2. Pedotectum II extends laterally further than I.



FIGURES 8–11. Right legs II, posterior aspect to femur–pretarsus. 8, *Hemileius (Hemleius) biclavulus* sp. nov.; 9, *Hemileius (Hemileius) copectus* sp. nov.; 10, *Hemileius (Tenuileius) minimus* sp. nov.; 11, *Hemileius (Tenuileius) paratenuis* sp. nov.

General morphology of Australian species

Colour, shiny yellowish-brown. Smallest species in genus (175–298). Legs short (mean femur–tarsus length: 37–38% of somal length) and tibiae very stout (mean maximum height: 52–59% of mean length). Limbus restricted to margin of hysteronotal shield behind slit-like pore *hf*4, narrow, width about 0.3× diameter of bothridium. Sacculate foramina with round pores.

Distribution

Currently *Tenuileius* appears to be confined to regions around the Pacific, species being recorded from Australia (Aa), Japan (Pc) and possibly Hawaii (Ap).

Remarks

Tenuileius includes two Australian species in which the hysteronotal shield is strongly tapered anteriorly, with no marginal thickening, and leaving the pleural striated cuticle, which extends unusually well forward, visible from above. Associated with this, seta Z1 is transposed backwards from the anterior margin of the hysteronotal shield and sometimes towards the mid-line. The anterior narrowing of the hysteronotal shield may have been overlooked in the past since it lies above a region including the highly refractile structures around the sejugal division. Therefore, *H. tenuis* Aoki, 1982 is included in the subgenus on the basis of other similarities to *H. paratenuis*. Also, it is noted that whilst *H. gressitti* Balogh & Balogh, 1983 is left in the nominate subgenus, it should be regarded as a potential candidate for inclusion in *Tenuileius* that awaits further examination. As pointed out in the 'Remarks' on the genus, members of this subgenus may be adapted to live in the deeper soil layers. If the adaptations are apomorphic, *Tenuileius* might be better reranked to be a genus. The following three species are grouped in *Hemileius (Tenuileius)*: *H. (T.) minimus* sp. nov., type-species; *H. (T.) paratenuis* sp. nov.; *H. (T.) tenuis* Aoki, 1982.

Hemileius (Tenuileius) minimus sp. nov.
Figs 10, 12 and 13

Female

Dorsal hysteronotal profile slim, oval. Idiosomal length, 190 (6, 185–200). Leg lengths (femur–tarsus for idiosomal length 187): I — 82, II — 67, III — 59, IV — 69. Tibial maximum heights (for 187): I — 15, II — 13, III — 12, IV — 12.

Proteronotum with complete prelamella (seta *j*1—rostral margin), costate near *j*1, rest linear. Lamella mainly laminar, linear near *z*2. Sublamella costate, runs close to lamella along anterior half, bothridium (base of seta *z*2) close to lamella. Subtutorium present, costate, dorsally extending to near seta *z*1. Setae *j*1, *j*2, *z*1 inconspicuously ciliate, interlamellar (*j*2) and lamellar (*z*1) setae medium-length, both only reaching level of *z*1 and *j*1 respectively. Sensory seta short, not reaching *j*2; exposed stalk shorter than caput, caput subglobose (laterally compressed), two ranks of cilia in six or seven files. Seta *s*2 length about 2× diameter of bothridial aperture.

Hysteronotal setae short (but nearly as long as *j*2), subequal in length, peripheral (*J*6, *Z*3, *S*6, *Z*6) setae slightly longer. Slit-like pore *hf*3 nearly transverse, adaxial end anterior; *hf*4 and *hf*5 near lateral margin, visible dorsally, *hf*6 partially visible dorsally.

Podosternum with moderately wide gap (slightly less than *I*1–*III*1) between apodemes I. Genital shield substantially closer to anal shield than anterior podosternal margin. Adaxial end of apodeme III base latitudinally level with coxite seta *III*1, and longitudinally level with coxite seta *IV*2. Custodial ridge present. Discidial ridge with inconspicuous discidium. No circumpedal ridge. Pedotectum II slim, but long, extending laterally beyond pedotectum I. No midcoxite sculpturing. Lateral coxite setae longer than those around mid-line.

Opisthosternum with genital setae evenly spaced and less than half length of anal setae. No eggs observed.

Legs short (mean femur–tarsus length: 37% of soma). Dorsal porose areas not evident on femurs and trochanters. Rugae posteriorly on femurs III and IV. No ventral keels or flanges on femurs. Solenidium *so*1 on tarsus I fatter than seta *d*3, reaching pretarsal claws. Six ventral setae on tarsus I, proximoventral seta *v*2 present, proximal four with 3 or 4 cilia (longest cilium longer than setal base diameter). Pretarsi with three claws (central stout claw, lateral slim claws).

Male

As female, except soma smaller, idiosomal length, 177 (2, 175–178).

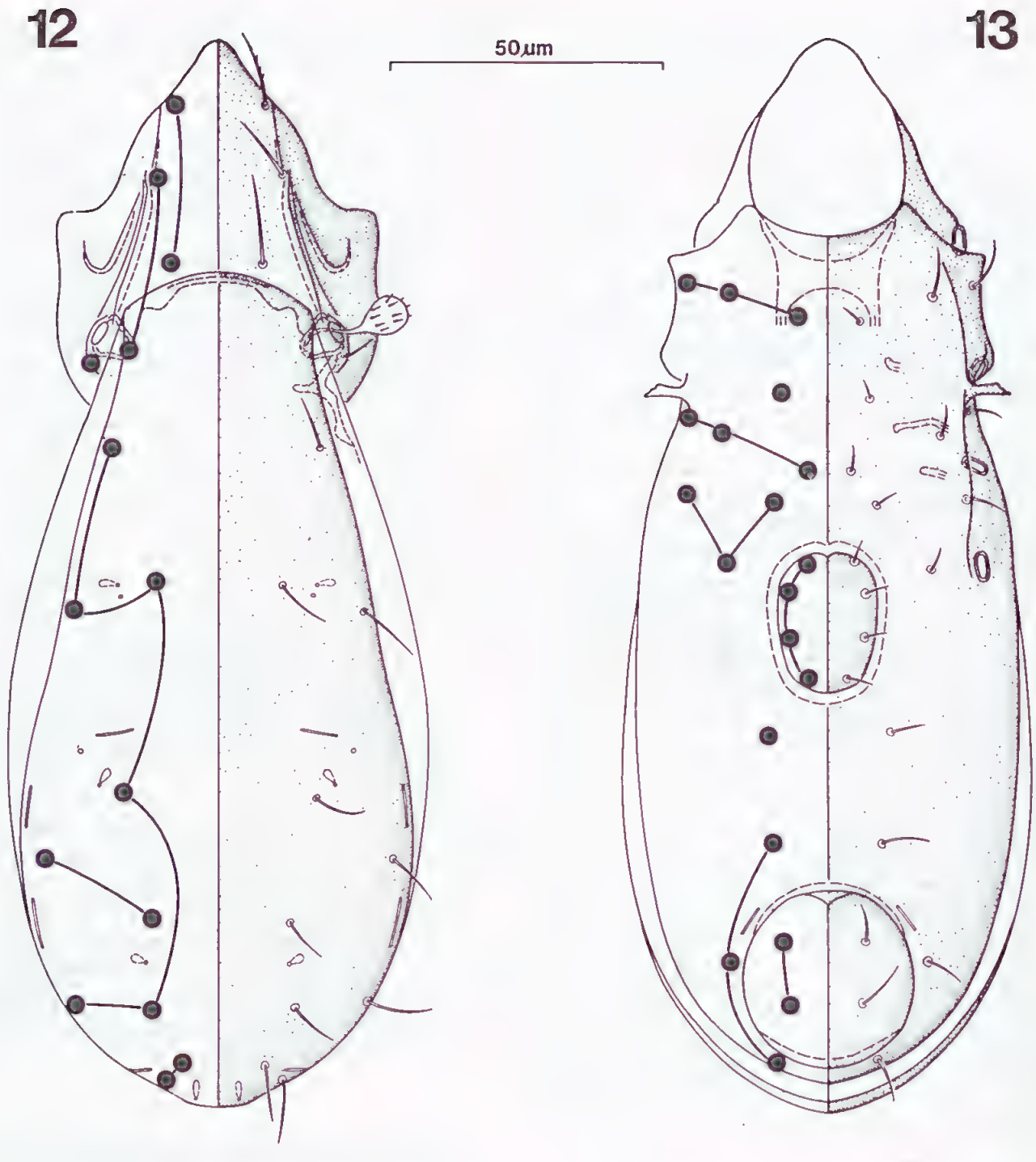
Material examined

Holotype: ♀ (N1988312); sand, litter, under banksia shrubs (*Banksia ornata*), Tamboore Homestead (35°57′S, 140°29′E), 4.viii.1974.

Paratypes: 5♀♀ (N1988313–N1988317), 2♂♂ (N1988318, N1988319); same data as holotype.

Distribution

Australia (Aa), South Australia. Mallee-heath, tall open shrubland (Tamboore Homestead, near Mt Rescue Conservation Park), Murray–Darling basin, 6♀♀, 2♂♂ / 1 of 8 × 25 cm².



FIGURES 12 AND 13. *Hemileius (Tenuileius) minimus* sp. nov., female soma. 12, notum; 13, idiosternum.

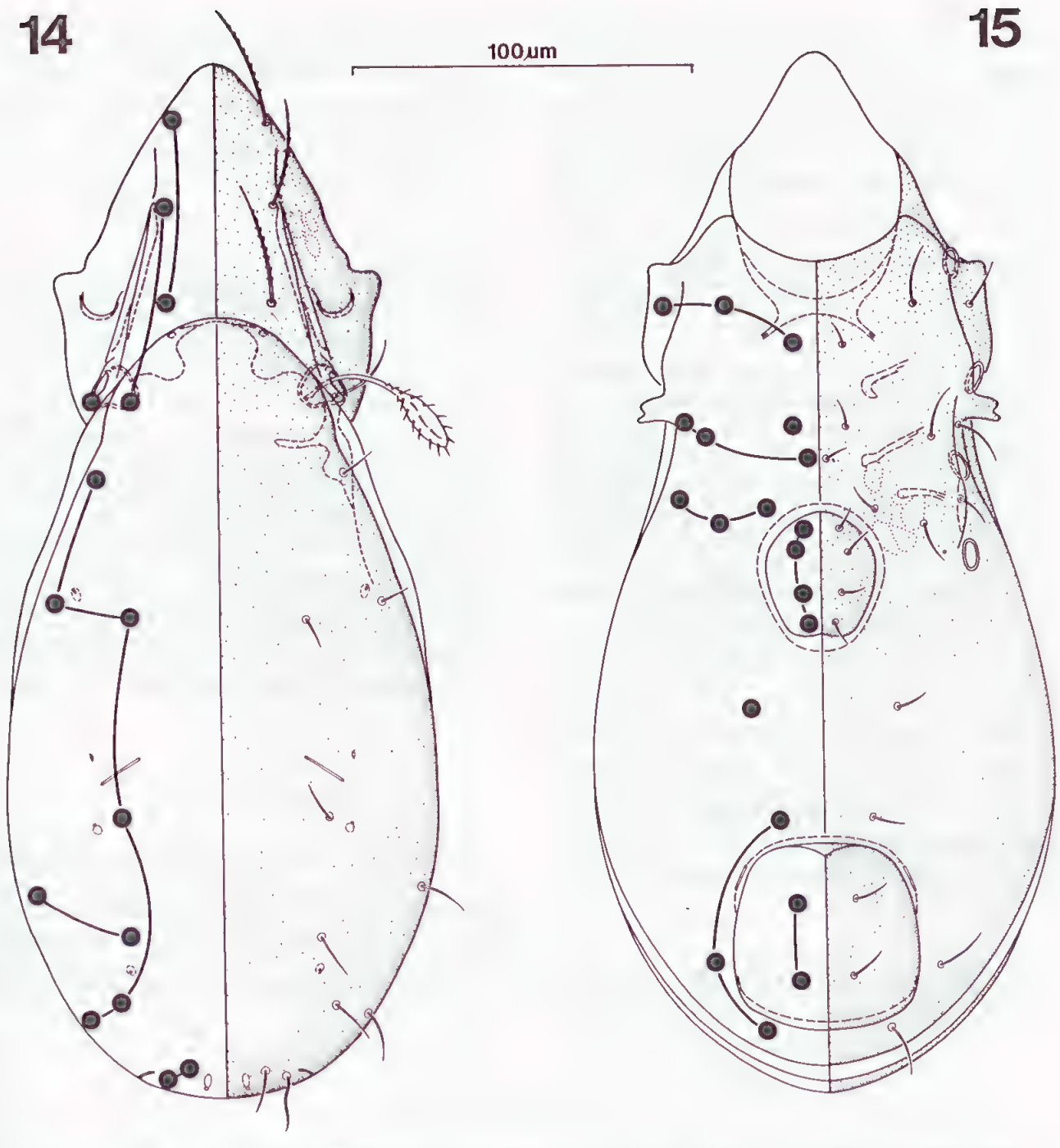
Remarks

H. (Tenuileius) minimus is the smallest, slimmest species of *Hemileius* so far known. It has a relatively large podosternal region, the shortest legs recorded for *Hemileius*, with short, stout tarsi, and extensive pleural striated cuticle, suggesting adaptation for burrowing, probably in a euedaphic habitat.

Hemileius (Tenuileius) paratenuis sp. nov.
Figs 11, 14 & 15

Female

Dorsal hysteronotal profile oval. Idiosomal length, 296 (3, 293–298). Leg lengths (femur–tarsus for idiosomal length 298): I — 136, II — 108, III



FIGURES 14 AND 15. *Hemileius (Tenuileius) paratenuis* sp. nov., female soma. 14, notum; 15, idiosternum.

— 90, IV — 113. Tibial maximum heights (for 298): I — 23, II — 15, III — 12, IV — 14.

Proteronotum either without prelamella or it is incomplete and lineate (Fig. 14). Lamella mainly laminar, linear near *z*2. Sublamella laminar, runs close to lamella along anterior half, bothridium (base of seta *z*2) close to lamella. Subtutorium present, costate, crescent-shaped. Setae *j*1, *j*2, *z*1 inconspicuously ciliate, interlamellar (*j*2) and lamellar (*z*1) setae medium-length, *j*2 reaching beyond level of *z*1 and *z*1 beyond level of *j*1. Sensory seta (*z*2) medium length, reaching beyond *j*2; exposed stalk longer than caput; caput fusiform, three files of cilia, median file with 7–8 cilia along caput and stalk, anterior and posterior files with 5–7 cilia confined to caput. Seta *s*2 length about 2.5× diameter of bothridial aperture.

Hysteronotal setae, subequal in length but posterior rank (*J*6, *Z*6, *S*6) longer, sometimes sinuous. Slit-like pore *hf*3 oblique, abaxial end posterior; on right side of one female, longitudinal slit-like pore between setae *Z*2–*Z*3, presumed *hf*2; *hf*4 and *hf*5 near lateral margin, visible laterally (not illustrated); only half of *hf*6 visible dorsally (Fig. 14).

Podosternum with moderately wide gap (slightly

less than *1I–1II*) between apodemes I. Genital shield closer to anal shield than anterior podosternal margin. Adaxial end of apodeme III base latitudinally level with point between coxite setae *IIII–IV*1 and longitudinally level with point midway between coxite setae *IV*1–*IV*2. Custodial ridge present. Discidium forms a shallow flap (depth subequal to diameter of setal base *IV*3). Circumpedal ridge absent. Weak alveolate sculpturing along midcoxite region (Fig. 15, illustrated only on coxite IV). Pedotectum II medium-breadth, long, extending further laterally than pedotectum I.

Opisthosternum with genital setae about two thirds length of anal setae. Genital chaetotaxy very variable, commonest pattern illustrated (Fig. 15), but also 2*JZg*, 3*JZg* and 5*JZg*, missing setae *JZg*2 and *JZg*3, extra seta between *JZg*3–*JZg*4, confined to one side; spacing varies for 4*JZg*, usually even, sometimes central space (*JZg*2–*JZg*3) extensive so that setae in two groups. No eggs observed.

Legs short (mean femur–tarsus length: 38% of soma). Porose areas on femurs and trochanters III and IV. Indistinct rugae on femurs I and II, distinct rugae on femurs III and IV. Keel with shallow flange on femur II. Solenidium *so*1 on tarsus I subequal in diameter to base of seta *d*3 and reaching to setae *d*4. Five ventral setae on tarsus I, proximoventral seta *v*2 absent, only one (*v*3) ciliate, with six or seven cilia (longest cilium subequal in length to setal base diameter) along two-thirds of length. Pretarsi with three claws (central stout claw, lateral slim claws).

Male

As female, except smaller soma, idiosomal length, 273 (5, 262–285).

Material examined

Holotype: ♀ (N1988320); soil, litter and sparse grass under coastal wattle (*Acacia sophorae*), Piccaninnie Ponds Conservation Park (38°03′S, 140°57′E), 3.vii.1974.

Paratypes: 2♀♀ (N1988321, N1988322), 5♂♂ (N1988323–N1988327), same data as holotype.

Distribution

Australia (Aa). South Australia. Coastal closed-scrubland (Piccaninnie Ponds Conservation Park), SE coastal, 3♀♀, 5♂♂ / 2 of 8 × 25 cm².

Remarks

H. (Tenuileius) paratenuis differs from the other two species of *Tenuileius* in having a fusiform sensory seta (*z*2). It is intermediate in size between these species. In details such as the circular pore to the hysteronotal foramina and presence of lateral coxite setae it resembles *H. (T.) minimus*, whilst in its general broader shape it more closely resembles *H. (T.) tenuis*. It is assumed here that *H. (T.) tenuis* has a narrow hysteronotal shield anteriorly, but this is not commented on in its description (Aoki 1982).

Acknowledgments

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A REVISION OF THE GENUS *PEDIANA* SIMON (HETEROPODIDAE: ARANEAE) IN AUSTRALIA

D. B. HIRST

HIRST, D.B. 1989. A revision of the genus *Pediana* Simon (Heteropodidae: Araneae) in Australia. *Rec. S. Aust. Mus.* 23(2): 113-126.

Australian species of the genus *Pediana* Simon, 1880; *P. horni* (Hogg, 1896), *P. occidentalis* Hogg, 1903, *P. regina* (L. Koch, 1875), type species, and *P. tenuis* Hogg, 1903 are revised. Males of those species are described for the first time. Specimens which Thorell, 1881 attributed to *Polydamna* (= *Pediana*) *regina*, are not that species. Two groups are recognised.

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The genus *Pediana* has received very little attention in literature apart from the original descriptions of the species. L. Koch (1875) described the first species as *Heteropoda regina* from Queensland. Both Thorell and Simon proposed a new genus for this species. Simon (1880) with *Pediana*, preceded Thorell (1881) who proposed the name *Polydamna* when describing specimens he considered to be *regina* from Yule Is. (the table on p. 698 gives '*Polydora regina*'). Hogg (1896) described *Isopeda horni* from South Australia, which he transferred to *Pediana* in 1903, at the same time describing two new species, *P. occidentalis* and *P. tenuis* from Western Australia.

All were originally described from females, males being unknown in literature except for Thorell's description of the male of *Polydamna regina*. Examination of that male shows that it is not *regina* but a possible new species which requires comparison with *P. aurichelis* Strand, 1907 from Java, the last species added to the genus. Types of the latter are lost (Renner, Stadtliches Museum für Naturkunde, pers. comm.) and the species is not considered here. The male palp of Thorell's specimen is illustrated and the species briefly discussed.

Pediana has remained an obscure genus judging by literature records and Museum collections. Simon (1908) redescribed a specimen correctly attributed to *P. tenuis*, while Strand (1913) gave a description of *P. horni* under the name of *P. regina* (var.?) [neither of those specimens have been examined]. Specimens of *P. tenuis* from Everard Ranges (in the South Australian Museum), were mis-identified as *Isopeda leishmanni* by Rainbow (1915). Many specimens deposited in Museums have been identified as *Isopeda* species, particularly *P. horni* and *P. tenuis*, in which the larger size and similar genitalia shape can be confusing. In the only other discussion of *Pediana*, Mascord (1970) gave brief notes on the genus giving some habitat preferences.

Materials and Methods

These notes supplement those given by Hirst (1989). Spination and colour common to all species are given under 'Remarks'. Colour in alcohol is given from recently preserved material. Eye measurements, given as relative to the diameter of an AME, are made on a horizontal plane, except PLE which are on the lateral declivity and measured on a vertical plane. Larger body and leg measurements are taken to the nearest 0.1 mm as most segments required more than one measure using an eyepiece graticule. This problem was compounded by the difficulty in positioning segments of brittle specimens perfectly horizontal for the required accuracy. Abbreviations are: AL = abdomen length, AW = abdomen width, CL = carapace length, CW = carapace width, L = length, W = width. Other abbreviations standard for Araneae. Acronyms: AM — Australian Museum, Sydney; BMNH — British Museum (Natural History), London; BYM — Dr B.Y. Main, Zoology Department, University of Western Australia, Perth; MCG — Museo Civico di Storia Natural 'Giacomo Doria', Genoa; MUZ — Museum Zoologiczne Wroctawskiego, Wroclaw; NMV — Museum of Victoria, Melbourne; NTM — Northern Territory Museum, Darwin; QM — Queensland Museum, Brisbane; SAMA — South Australian Museum, Adelaide; SMNS — Stadtliches Museum für Naturkunde, Stuttgart; WAM — Western Australian Museum, Perth; ZMH — Zoologisches Museum, Hamburg.

Pediana Simon

Pediana Simon, 1880: 258. Type species: *Heteropoda regina* L. Koch 1875, by original designation and monotypy.

Polydamma Thorell, 1881: 299. Type species: *Polydamna regina* by original designation and monotypy. ♂, Penultimate ♀, Yule Island, MCG, examined.

Heteropoda [part] Koch, 1875: 716.
Isopeda [part] Hogg, 1896: 340.

Diagnosis

Carapace about three to four times longer than high. Lateral eyes raised on low common mound. Anterior row recurved, posterior row procurved. MOQ longer than wide. Anterior legs of equal length or leg I subequal to leg II. Abdomen elongate, pointed posteriorly, up to twice as long as wide. Male palp with embolus coiled 2½–5 times, coil stack wide and of low profile. Palpal tibia with large retrolateral distal apophysis having a dorsal basal ridge.

Description

Medium to large spiders. Two groups are recognised. One contains *P. regina, P. occidentalis* and Thorell's species (*regina* group), the other, *P. horni* and *P. tenuis* (*horni* group). Carapace length 3–9 mm (*regina* group) or 6–12 mm (*horni* group), longer than wide, highest posterior to ocular region. ALE largest. PME dome shaped, clearly visible in lateral view. Clypeus ½ to ⅞ width of AME. Cheliceral groove with two promarginal teeth, three or four retromarginal teeth, rarely five. Labium barely wider than long, with rounded apex. Sternum longer than wide, truncate anteriorly, narrowing from second coxae to a short point posteriorly. Three pairs of ventral spines on tibiae of the *horni* group with distal pair adjacent to articulation with metatarsi. Distal spine pair often absent in the *regina* group. Juveniles of both groups lack the distal pair. Patella IV equal in length to patella III, both may be without retrolateral spines. Scopula on metatarsi IV largely replaced by long bristles. Abdomen up to twice as long as wide (except in gravid females), pointed posteriorly, with pattern of black spots comprised of short adpressed setae which point posteriorly and inwards towards centre line of each spot. Ventrally with two black patches, one posterior to epigastric furrow, the other anterior to spinnerets. The latter patch may be faint or occasionally absent. Male tibial apophysis equal in length to palpal tibia with basal dorsal ridge, pointed apically. Embolus coiled in distal half of cymbium 2½ (*regina* group) or 5 times (*horni* group) with the terminal portion of the embolus resting in groove of a modified loosely spiralled conductor. Coil stack broad at first, then of decreasing width, profile low. Female epigynum large, oblong with somewhat parallel sides to broadly triangular. Fossa large, whitish, slightly translucent often allowing the spermathecae or spermathecal sacs to be seen beneath, slightly concave, smooth except posteriorly, laterally overhung by broad sclerotised lateral rim. Fossa and sclerotised rim lacking setae. Vulva paired, insemination ducts coiled two to three times (*regina* group) or 5 to 6 times (*horni* group) around spermathecae leading back to adjacent anterior margin of fossa with gentle arc (*horni* group) or with large spermathecal sacs extending to median ventral position (*regina* group) before looping back anterior to fossa, continuing as fertilisation ducts under lateral rims to posterior margin.

Remarks

Mascord (1970) stated *Pediana* was rather shorter in the legs than most huntsman spiders, but this is a visual interpretation affected by the relatively longer abdomen and anterior legs being of equal length. Leg I ratio (leg length divided by carapace length) is comparable with that of many other Australian huntsman spiders particularly *Neosparassus* and some species presently in *Isopeda*. However, leg II of females is relatively shorter than in most other Australian Heteropodidae.

In his key to species included in *Pediana*, Hogg (1903) stated there were no dorsal spines on the posterior tibiae of *P. horni*. This contradicts his original description of one spine on each, which the syntype and other material examined possesses. Tibiae of all species usually with one dorsal spine but *horni* group most often with two on anterior pairs. Thorell's species, while placed here in the *regina* group, has a similar spination to the *horni* group. Usual spination of the *horni* group is as follows: palps, fe d3 p1 r1 (all distal), pa p1 r1, ti d1 p3 r2 (male r1), ta p3 r variable between 1–3 (male p0 r0); leg I and II, fe d2 p3 r3, pa p1 r1, ti d2 p2 r2 v6, me p2 r2 v4; leg III, fe d2 p3 r3, pa p1 r1, ti d1 p2 r2 v6, me p2 r2 v4; leg IV, fe d2 p3 r1, pa p1, ti d1 p2 r2 v6, me p4 r4 v4.

The *regina* group as stated above, differs in having one dorsal spine on anterior tibiae (again with the exception of Thorell's species) and often only two spine pairs ventrally on tibiae, lacking the extreme distal pair. This may be represented as a stout bristle, particularly in males, or as a proventral spine on anterior tibiae. Retrolateral patellae spines are usually absent on leg III as well as IV.

Coloration of *Pediana* species is similar. Colour photographs of *P. regina* (in life) can be found in Mascord (1970: 39, Figs 55, 56). Colour in alcohol is paler, of reddish and yellow-brown hues suffused with black. Carapace is reddish-brown, caput darker. Dense adpressed, yellow, orange or whitish setae, interspersed with black. Clumps of black setae often form spots along sides. A thick line of black setae just above posterio-lateral margin runs slightly into posterior edge. Black setae around fovea occasionally extend in a line towards caput. Chelicerae reddish, basal half with adpressed white and orange setae. Distal half with erect long setae only. Maxillae and labium blackish, pale anterior

margins. Sternum yellowish to dark brown, margins paler. Legs red-brown proximally to tibia then dark brown or blackish distally to tarsi. Setae similar to carapace, femora ventrally spotted with clumps of white or orange-red setae. Abdomen dorsally yellow-brown to olive-grey with setae as on carapace. Median stripe of black setae usually faint, occasionally vivid. Ventrally yellowish to orange with black spots. Two large black patches, one behind epigastric furrow, the other anterior to spinnerets. Sclerotised area around fossa often bright orange-red.

The tegulum of the unexpanded male palp is largely covered by a disc-shaped embolar base (Fig. 1) where a sclerotised plate, which may be part of the median apophysis, is incorporated. The embolar base in the *regina* group is ridged prolaterally on the distal margin with an indented area proximally to this. A small median apophysis is adjacent to the embolus origin. In the *horni* group the embolar base is larger with a low ridge distally and lacks an indented area proximal to this. A swollen, well-developed median apophysis is somewhat removed from the embolus origin. The embolus itself begins on the retrolateral side. The membranous conductor rises pro-distal from the embolar base in the *regina* group but proximally in the *horni* group.

Distribution (Fig. 11)

Although widespread, these spiders do not appear to be common. *P. regina* is known from the north-east coast of Queensland to southern New South Wales. While *P. horni* is found in arid areas across the centre of the continent, *P. tenuis* is found in the arid areas of Western Australia and western South Australia. *P. occidentalis* is known from semi-arid areas of southern Western Australia. One record of a female from the Flinders Ranges of South Australia is tentatively placed in that species (*see later*). *P. regina* has a distribution disjunct from the other species, while *P. tenuis* overlaps *P. horni* in the northern part of its range and *P. occidentalis* in Western Australia on the southern part of its range.

KEY TO THE AUSTRALIAN SPECIES OF *PEDIANA*

1 —Anterior tibiae usually with 1 dorsal spine and 2 ventral spine pairs. Male with embolus coiled 2½ times 2
— Anterior tibiae usually with 2 dorsal spines and 3 ventral spine pairs. Male with embolus coiled 5 times 3

2 —Venter of abdomen with orange setae. Male embolar base with small median apophysis ..... *regina* (L. Koch)
— Venter of abdomen with yellow setae. Male embolar base with broad median apophysis ..... *occidentalis* Hogg

3 —Anterior femora with white spots. Male with curved dorsal basal ridge on palpal tibial apophysis ..... *horni* (Hogg)
— Anterior femora with reddish spots. Male with straight-sided dorsal basal ridge on palpal tibial apophysis ..... *tenuis* Hogg

The *Regina* Group

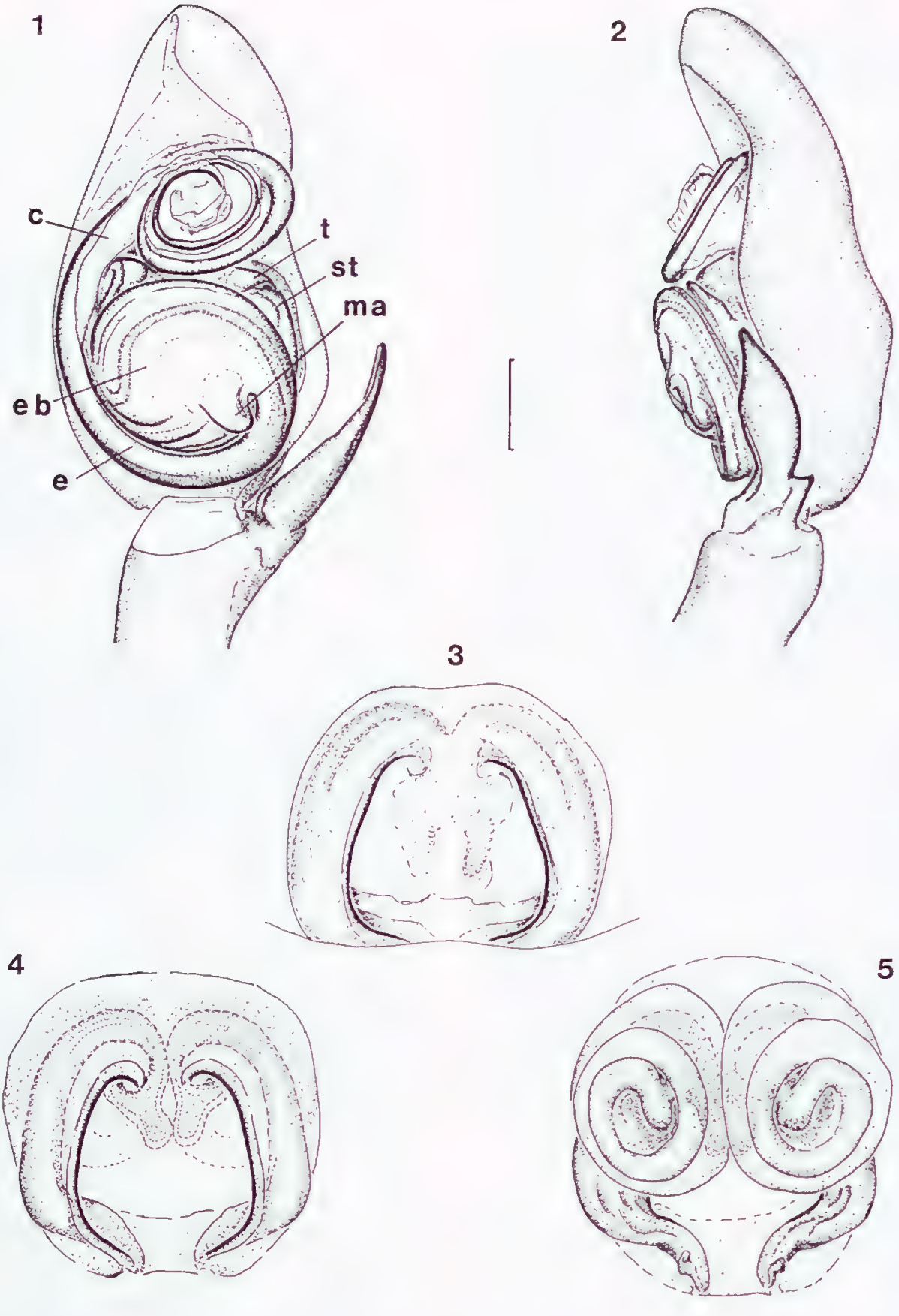
Comprises *P. regina, P. occidentalis* and Thorell's species from Yule Island. Males with about 2½ embolar coils, conductor beginning adjacent distal pro-margin of embolar base. Embolar base indented prolaterally, median apophysis small and adjacent origin of embolus. Portion of division between subtegulum and tegulum visible on retrolateral side when viewed ventrally. Females with large spermathecal sacs. Insemination ducts coiled 2-2½ times.

Pediana regina (L. Koch)
(Figs 1-5, Table 1)

Heteropoda regina L. Koch, 1875: 716. One of two known syntype females from Peak Downs, Queensland, 22°56′S, 148°05′E, ZMH (Mus. Godeffroy Nr 14602), examined. L. Koch (1875) mentions material from Bowen, Peak Downs and

TABLE 1. Leg measurements of *Pediana regina* (L. Koch) syntype female with male QM S7196 in parentheses.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	8.4 (9.7)	3.6 (3.2)	7.1 (9.5)	7.2 (9.2)	2.3 (2.3)	28.6 (32.9)
II	8.8 (10.1)	3.6 (3.2)	7.5 (10.0)	7.3 (9.3)	2.2 (2.3)	29.4 (34.9)
III	6.7 (7.2)	2.8 (2.2)	5.5 (6.5)	5.1 (5.9)	1.9 (1.8)	22.0 (23.6)
IV	8.0 (9.0)	2.8 (2.2)	6.4 (8.3)	6.9 (9.0)	2.0 (2.1)	26.1 (30.6)
Pa	2.8 (2.4)	1.4 (1.0)	1.7 (1.0)	— —	3.1 (2.8)	9.0 (7.2)



FIGURES 1–5. *Pediana regina* (L. Koch). 1 & 2, left palpal tibia and tarsus of male QM S7196: 1, ventral; 2, retrolateral. 3, epigynum of syntype female. 4 & 5, vulva of SAMA N1988471: 4, ventral; 5, dorsal. Scale line 0.5 mm. c, conductor; e, embolus; eb, embolar base; ma, median apophysis; st, subtegulum; t, tegulum.

Cape York without stating the number of specimens. One female in NMV (K-0873) examined, with the same number (14602) as the syntype above, but with no other data, is a possible syntype. A female from Bowen (not examined) is in the BMNH. The Cape York material, deposited in the Bradley Collection, may have found its way to MUZ (Wroclaw) in which case, was probably lost during World War II or possibly is in the Macleay Museum, Sydney, but has not yet been found.

Pediana regina Simon, 1880: 258.

Diagnosis

Anterior femora blackish with white spots, orange-yellow venter of abdomen. Females with broad, triangular-shaped fossa. Male palp with broad tibial apophysis, bulb with small median apophysis.

Syntype female

CL 7.9, CW 7.4. AL 13.2, AW 9.2.

Colour in alcohol: In addition to that under 'Remarks', carapace with orange and white setae, white setae grouped on anterior lateral corner of carapace and on basal half of chelicerae, particularly below boss. Anterior femora ventrally blackish with clumps of white setae. Abdomen yellow-brown laterally with orange spots towards venter. Ventrally with orange setae. May have short transverse mark of brown setae between epigynum and pedicel.

Eyes: AME diameter 0.58. AME:ALE:PME:PLE = 1:1.17:0.83:0.86. Interspaces; AME-AME 0.30, AME-ALE 0.10, PME-PME 1.20, PME-PLE 1.14, AME-PME 1.52, ALE-PLE 1.20. MOQ, anterior width: posterior width: length = 2.62:2.84:3.17. Clypeus half width of AME. Chelicerae: Retromargin of right chelicera with 4 teeth, 5 on left. Labium: L 1.2, W 1.5. Sternum: L 3.9, W 3.5.

Legs (Table 1): Anterior leg ratios = (leg I) 3.6, (leg II) 3.7. Fossa broad posteriorly. Vulva (of SAMA N1988471) with insemination ducts coiled about 2½ times.

Male QM S7196

CL 5.7, CW 5.3. AL 7.0, AW 3.8.

Colour in alcohol: Yellow setae somewhat clustered on anterior half and laterals of carapace. Median cluster of yellow setae on basal half of chelicerae, whitish laterally. Sternum orange-brown suffused with black.

Eyes: AME diameter 0.41. AME:ALE:PME:PLE = 1:1.07:0.85:0.90. Interspaces; AME-AME 0.39, AME-ALE 0.10, PME-PME 1.17, PME-PLE 1.12, AME-PME 1.56, ALE-PLE 1.07. MOQ, anterior width: posterior width: length = 2.00:2.83:3.41. Clypeus equals width of AME.

Chelicerae: Retrolateral teeth 5. Labium: L 0.9, W 1.0. Sternum: L 2.8, W 2.6.

Legs (Table 1): Anterior leg ratios = (I) 5.8, (II) 6.1. Tibial index (leg I) = 7.6.

Palp: Embolus with 2½ coils.

Variation

Carapace length of females range from 5.0–8.5 (n = 23, mean = 6.7). Males; 3.5–6.0 (n = 9, mean = 5.2). Tibial index of Leg I of males; 6.7–9.1 (n = 9, mean = 7.9). Most often with 4 retrolateral cheliceral teeth.

Comments

Thorell's *Polydamna regina* material of one male and a penultimate female from Yule Island, differs from *regina* in its larger size, blackish caput, and less patterned abdomen with yellowish venter. Leg proportions and spination resemble the *horni* group. The male further differs in the apex of the dorsal ridge on the palp tibial apophysis resembling that of *P. horni* (Figs 12–13).

Other material examined

Queensland: 1 ♀, Bell, Darling Downs, 26° 56′S, 151°27′E, QM S7188; 2 ♂♂, Black Duck Creek, 27°54′S, 152°13′E, QM S7214; 1 ♀, Black Mountain, ?15°40′S, 145°14′E, QM S7191; 1 ♀, Black Mountain, Kuranda area, AM KS20195; 1 ♀, Byfield, 22°50′S, 150°38′E, AM KS19724; 1 juv. Calamvale, 27°37′S, 153°02′E, QM S7187; 1 ♀, Camira, Brisbane, QM S6563; 1 ♂, Cooloola, 26°12′S, 153°05′E, QM S7196; 1 juv. Enfield Station, 27°06′S, 151°02′E, QM S7202; 1 ♀, Fanning River Stn, 19°44′S, 146°26′E, AM KS19669; 1 ♂, same data, AM KS20203; 1 ♀, Gin Gin, 25°00′S, 151°57′E, SAMA N1988471; 1 ♂, Gracemere, 23°26′S, 150°27′E, AM KS16650; 1 ♀, Ipswich, 27°37′S, 152°47′E, QM S7197; 1 ♀, Koah, 16°49′S, 145°31′E, AM KS20196; 1 ♂, Lake Broadwater, 27°21′S, 151°06′E, QM S7185; 2 ♀ ♀, Lake Nuga Nuga, 25°01′S, 148°42′E, QM S7215; 1 ♂, Marlaybrook, 26°54′S, 151°36′E, QM S7186; 1 ♀, Miriam Vale, 24°20′S, 151°34′E, AM KS20197; 1 juv., Mt Coot-tha, 27°28′S, 152°58′E, QM S7200; 1 ♁, same locality, QM S7217; 1 ♁, Mt Molloy, 16°41′S, 145°20′E, QM S7192; 1 ♂, Mt Nebo, Brisbane, QM S7189; 1 ♁, Nankin Creek, Rockhampton, 23°24′S, 150°39′E, AM KS19730; 1 ♂, North Booval, 25°12′S, 152°02′E, QM S7216; 1 ♀, Peach Creek, 13°41′S, 143°09′E, QM S7193; 1 ♀, Proserpine, 20°24′S, 148°35′E, QM S7184; 1 ♂, Rochedale, Brisbane, QM S7190; 1 ♂, same locality, QM S7201; 2 juv. same locality, QM S7203; 1 ♀, Rundle Range, 23°40′S, 151°00′E, QM S7199; 1 ♀, The Fork-Mt Moffat area, 25°04′S, 148°03′E, QM S6862; 1 ♀, Wynnum, 27°27′S, 153°10′E, QM S7194; 1 ♀, Yeppoon, 23°08′S, 150°44′E, QM

S7198. **New South Wales:** 1 ♀, Cessnock, 32°50′S, 151°21′E, AM KS20199; 1 ♀, Jenolan Caves, 33°49′S, 150°02′E, AM KS20193; 1 ♂, 1 ♀, Pittwater, Sydney, AM KS20198; 1 ♀, Sydney, 33°53′S, 151°13′E, AM KS20192; 1 ♀, West Pymble, Sydney, AM KS20194.

Pediana occidentalis Hogg
(Figs 6–10, Table 2)

Pediana occidentalis Hogg, 1903 : 461. Two syntype females, Perth, Western Australia, 31°57′S, 115°51′E, H.W.J. Turner. Pinned specimens in alcohol, BMNH. 1893.7.4.47–100 part, examined.

Diagnosis

From *regina*; femora without black ventrally, abdomen yellowish ventrally. Males with relatively shorter, thicker legs, broader median apophysis and narrower palp tibial apophysis.

Syntype female (largest)

CL 6.6, CW 6.0. AL 8.5, AW 6.0.

Colour in alcohol: Anterior femora reddish-yellow suffused with black but not as darkly as in *regina*. More white setae on carapace. Abdomen yellowish ventrally.

Eyes: AME diameter 0.45. AME:ALE:PME:PLE = 1:1.33:1.00:1.11. Interspaces; AME–AME 0.48, AME–ALE 0.20, PME–PME 1.24, PME–PLE 1.38, AME–PME 1.69, ALE–PLE 1.33. MOQ, anterior width: posterior width: length = 2.44:3.16:3.33. Clypeus equals ⅔ width of AME.

Chelicerae: Retromarginal teeth 3. Labium: L 0.9, W 1.3. Sternum: L 3.3, W 2.8.

Legs (Table 2): Anterior leg ratio = 3.8.

Fossa broad posteriorly but relatively narrower than in *regina*. Vulva (of WAM 88/945) with insemination ducts coiled 2–2½ times. Spermathecal sacs may be relatively larger than in *regina*.

Male WAM 88/940

CL 5.8, CW 4.7. AL 5.5, AW 3.3.

Colour in alcohol: With more white setae on lateral edges of carapace and chelicerae. Anterior femora lightly suffused with black, less conspicuous white spots.

Eyes: AME diameter 0.35. AME:ALE:PME:PLE = 1:1.20:0.91:1.09. Interspaces; AME–AME 0.46, AME–PLE 0.06, PME–PME 1.20, PME–PLE 1.14, AME–PME 1.89, ALE–PLE 1.14. MOQ, anterior width: posterior width: length = 2.46:3.03:3.26. Clypeus equals ¾ width of AME.

Chelicerae: Left chelicera with 3 retrolateral teeth, 4 on right. Labium: L 0.7, W 0.9. Sternum: L 2.6, W 2.4.

Legs (Table 2): Anterior leg ratios = (I) 4.6, (II) 4.7. Tibial index (leg I) = 9.1.

Palp: Embolus with 2½ coils. Median apophysis broader than in *regina*, tibial apophysis narrower.

Variation

Carapace length of females range from 5.8–6.6 (n = 4, mean = 6.3). Males; 4.6–5.3 (n = 3, mean = 4.9). Tibial index of leg I of males; 9.3–10.6 (n = 3, mean = 9.7). Often with 4 retrolateral cheliceral teeth.

Comments

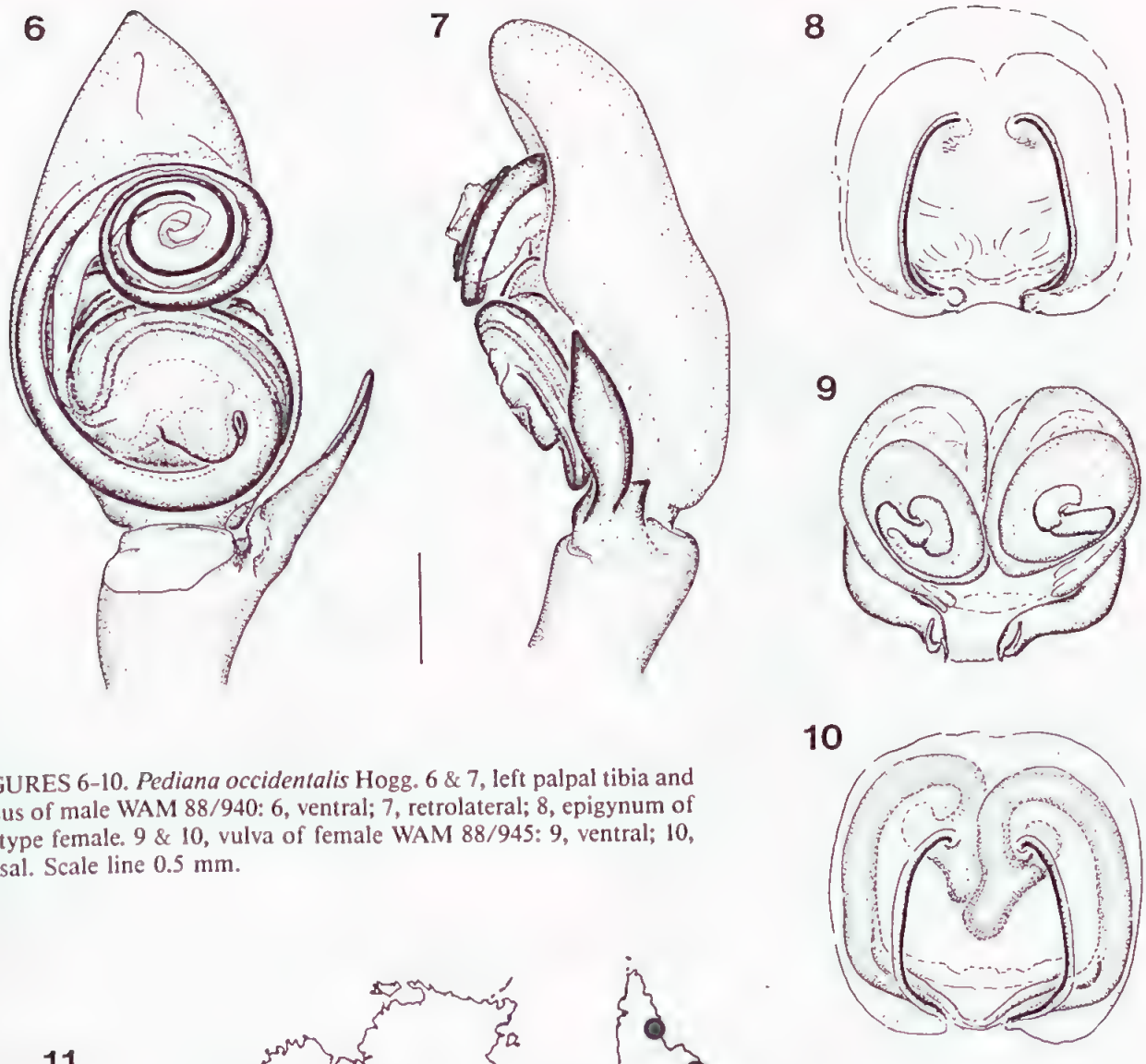
A female from the Flinders Ranges in South Australia is tentatively included in this species although the differences in the epigynum and vulva shape (narrower posteriorly than *occidentalis* with insemination ducts positioned more anteriorly) are comparable with that of *regina* and *occidentalis*. Clarification of this specimen's affinities will remain uncertain until male specimens from the region become available.

Other material examined

Western Australia: 1 ♂, Darlington, 31°55′S, 116°04′E, WAM 88/940; 1 ♂, Goongarrie, 29°55′S, 121°15′E, WAM 88/942; 1 ♀, Mt Pleasant, 33°49′S, 115°50′E, WAM 88/944; 1 ♂,

TABLE 2. Leg measurements of *Pediana occidentalis* Hogg, syntype female (largest) with male WAM 88/940 in parentheses.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	7.5 (7.9)	3.2 (2.7)	6.3 (7.2)	6.2 (7.1)	1.9 (1.9)	25.1 (26.8)
II	7.5 (8.2)	3.2 (2.7)	6.3 (7.6)	6.2 (7.1)	1.9 (1.9)	25.1 (27.5)
III	6.0 (6.2)	2.5 (2.1)	5.0 (5.5)	4.4 (5.0)	1.4 (1.5)	19.3 (20.3)
IV	7.4 (7.8)	2.5 (2.2)	5.8 (6.5)	6.1 (7.4)	1.6 (1.8)	23.4 (25.7)
Pa	2.2 (2.1)	1.1 (0.9)	1.5 (1.0)	— —	2.7 (2.5)	7.5 (4.5)



FIGURES 6–10. *Pediana occidentalis* Hogg. 6 & 7, left palpal tibia and tarsus of male WAM 88/940: 6, ventral; 7, retrolateral; 8, epigynum of syntype female. 9 & 10, vulva of female WAM 88/945: 9, ventral; 10, dorsal. Scale line 0.5 mm.

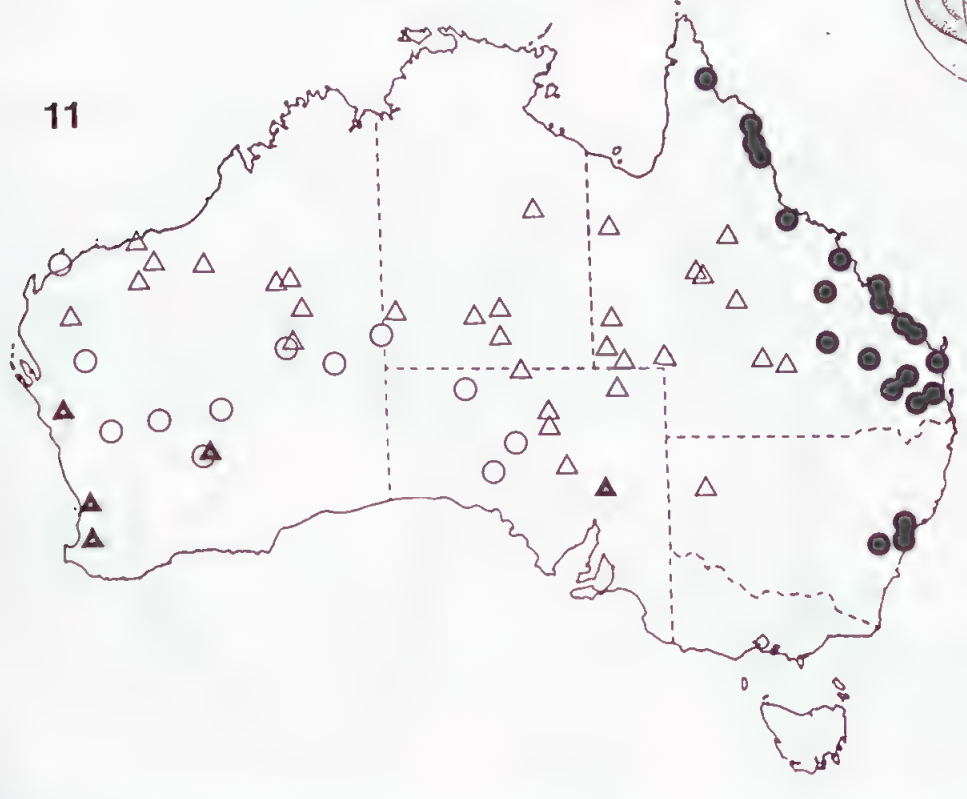
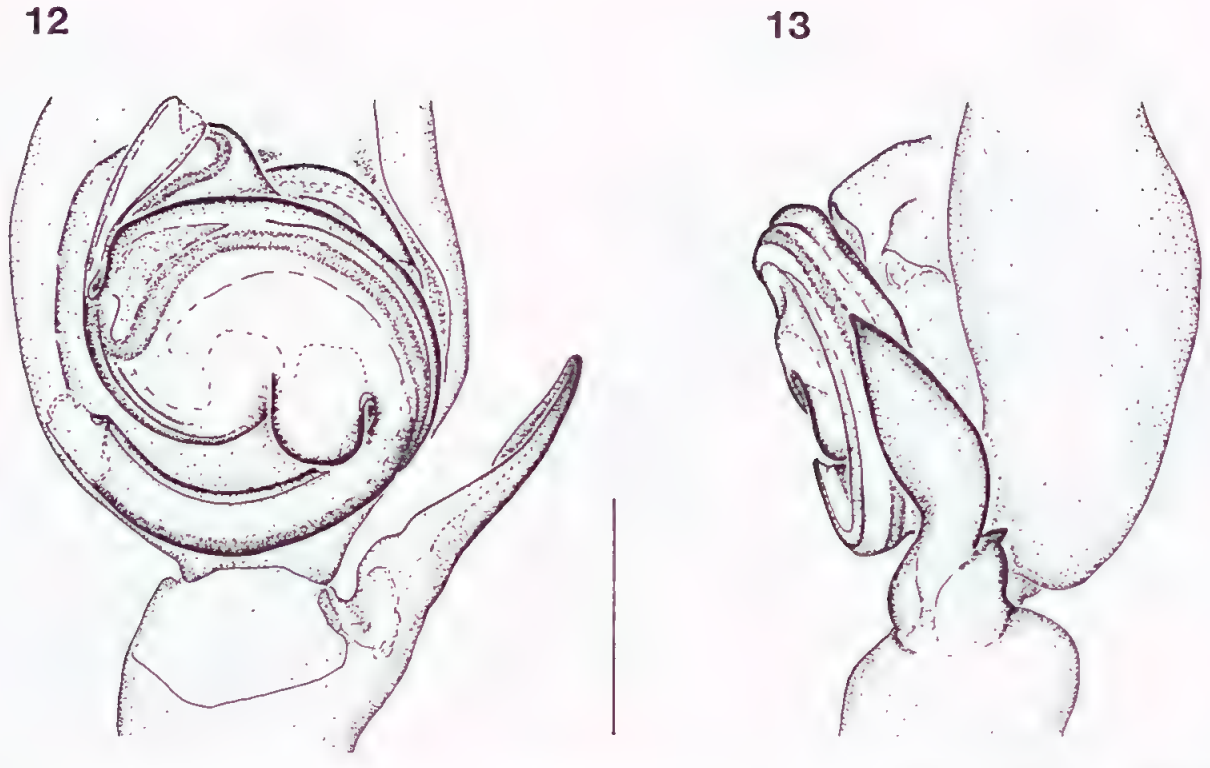
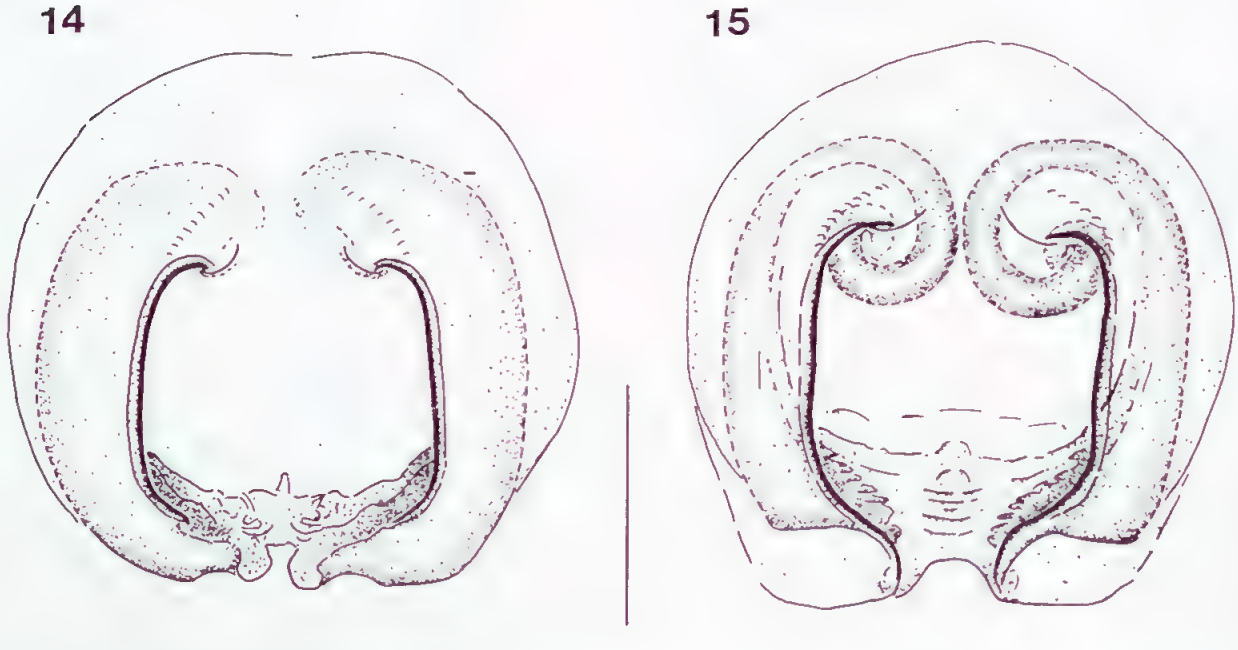


FIGURE 11. Distribution of *Pediana* in Australia: ● *Pediana regina* (L. Koch); ▲ *P. occidentalis* Hogg; ○ *P. horni* (Hogg); △ *P. tenuis* Hogg.



FIGURES 12 & 13. '*Polydamma regina*' Thorell. Left palpal tibia and tarsus of syntype male: 12, ventral; 13, retrolateral. (Distal part of embolus missing.) Scale line 0.5 mm.



FIGURES 14 & 15. *Pediana horni* (Hogg). 14, epigynum of syntype female, BM(NH); 15, vulva of female SAMA N1988462, ventral. Scale line 0.5 mm.

Murchison River, *ca* 27°31′S, 115°43′E, BYM 1962/A22; 1 ♀, Nedlands, 31°59′S, 115°48′E, WAM 88/945; 1 ♀, Walyunga, *ca* 31°50′S, 116°10′E, AM KS14975. South Australia; 1 ♀, Wilpena Pound, 31°30′S, 139°19′E, SAMA N1988472.

The *Horni* Group

Comprising *P. horni* and *P. tenuis*, this group is characterised in having more numerous long setae (*ca* 1.5) ventrally on leg four, males with about 5 embolar coils, conductor beginning in the proximal area of the embolar base, embolar base convex prolaterally, median apophysis large and slightly removed from origin of embolus. Females lack spermathecal sacs. Insemination ducts with 5 coils.

Pediana horni (Hogg)
(Figs 14–18, Table 3)

Isopeda horni Hogg, 1896: 340. Two syntype females, Oodnadatta, South Australia, 27°33′S, 135°27′E, Horn Expedition, BMNH. 1871.1.18.2 and NMV K-0872, examined.
Pediana horni: Hogg, 1903: 462.

Diagnosis
Anterior femora with conspicuous white spots ventrally, male with curved apical point on dorsal ridge of palp tibial apophysis.

Syntype female BMNH
CL 9.8, CW 9.3. AL 19.5, AW 13.0.
Colour in alcohol: As in Hogg (1903) and above. Eyes: AME diameter 0.64. AME:ALE:PME:PLE = 1:1.16:0.86:0.97. Interspaces; AME–AME 0.47, AME–ALE 0.16, PME–PME 1.09, PME–PLE 1.41, AME–PME 1.47, ALE–PLE 1.19. MOQ, anterior width: posterior width: length = 2.34:2.75:3.03. Clypeus width more than ½ AME. Chelicerae: Retrolateral teeth 3. Labium: L 1.5, W 1.9. Sternum: L 4.8, W 4.2.
Legs (Table 3): Anterior leg ratio = 3.5.
Fossa with somewhat parallel lateral sides.

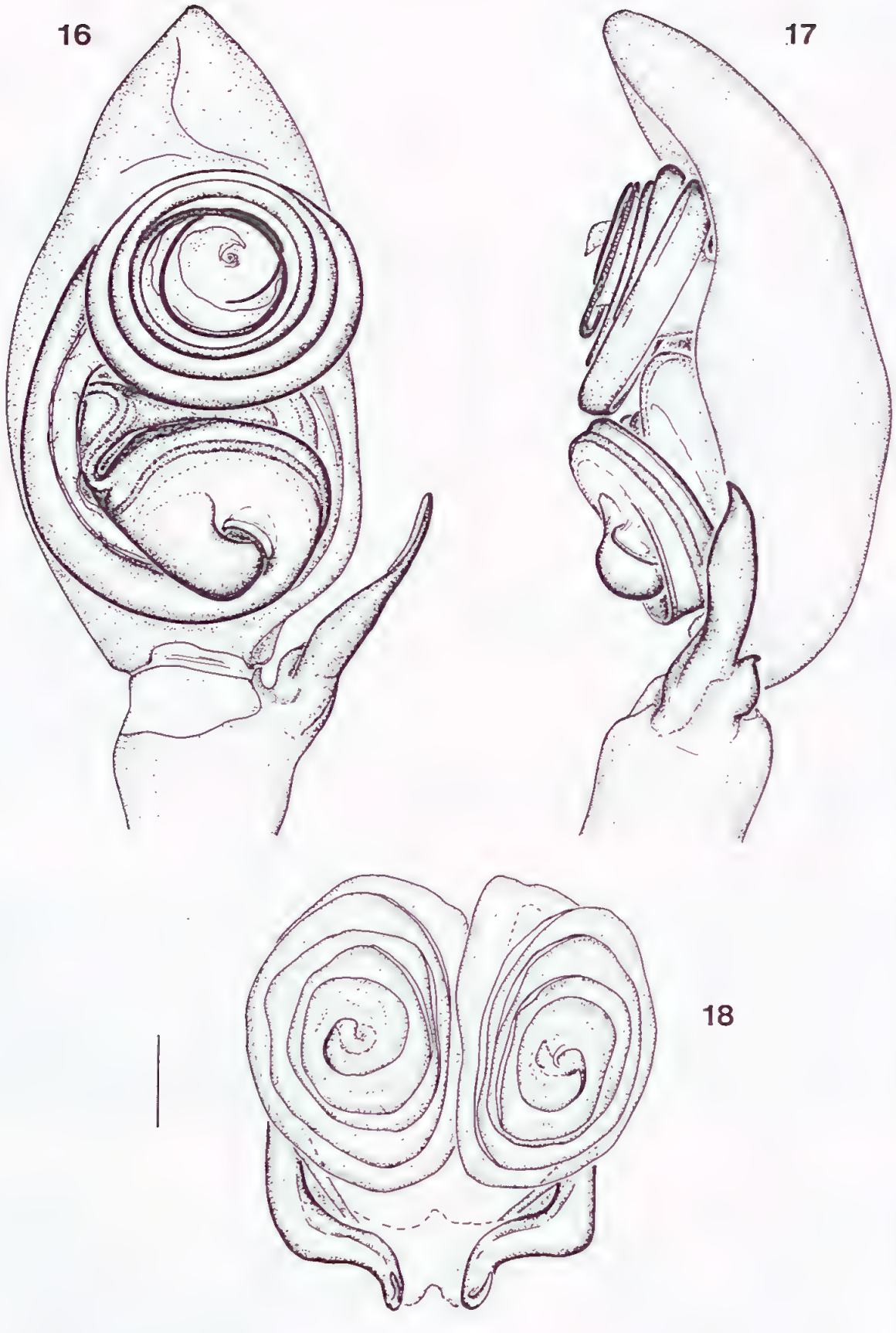
Male SAMA N1988458
CL 9.2, W 8.3. AL 9.7, AW 6.0.
Eyes: AME diameter 0.6. AME:ALE:PME:PLE = 1:1.07:0.83:0.93. Interspaces; AME–AME 0.33, AME–ALE 0.13, PME–PME 1.17, PME–PLE 1.27, AME–PME 1.49, ALE–PLE 1.17. MOQ, anterior width: posterior width: length = 2.33:2.83:3.17. Clypeus width ⅚ of AME. Chelicerae: Retrolateral teeth 3. Labium: L 1.4, W 1.6. Sternum: L 4.2, W 3.5.
Legs (Table 3): Anterior leg ratio = 4.5. Tibial index (leg I) = 10.3.
Palps: Tibial apophysis with curved apical point on basal ridge. Embolus with 5 coils.

Variation
Carapace lengths of females range from 6.1–12.5 (n = 23, mean = 9.5). Males; 6.9–9.8 (n = 5, mean = 8.3). Tibial index of leg I of males; 8.4–10.6 (n = 5, mean = 9.5). A vivid black streak is sometimes present dorsally on the abdomen. Fossa may be slightly wider or narrower posteriorly. Two of four females examined from Ambathala, Queensland, are smallish with decidedly elongated abdomens and relatively smaller epigyne but there is no justification for removing them to another taxa.

Other material examined
South Australia: 1 ♂, Clifton Hills, 27°03′S, 138°59′E, SAMA N1988458; 1 ♀, Finke River, 40 km from Abminga, *ca* 26°03′S, 135°53′E, AM KS20191; 1 juv. Olympic Dam, 30°27′S, 136°53′E, SAMA N1988463; 1 ♀, The Peake–Mt Denison area, 28°09′S, 135°57′E, SAMA N1988461; 1 ♀, Road to Oodnadatta, 28°35′S, 135°53′E, SAMA N1988462. **Western Australia**: 2 juv. Canning Stock Route, 22°32′S, 124°24′E, WAM 88/1483-4; 1 juv.

TABLE 3. Leg measurements of *Pediana horni* (Hogg) syntype female BM(NH), with male SAM N1988458 in parentheses.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	10.3 (12.0)	4.6 (4.6)	8.3 (11.0)	8.3 (10.9)	2.5 (2.9)	34.0 (41.4)
II	10.3 (12.0)	4.5 (4.5)	8.4 (11.1)	8.3 (10.9)	— (2.9)	— (41.4)
III	7.7 (9.0)	3.7 (3.6)	6.3 (7.9)	5.4 (7.1)	2.2 (2.2)	25.3 (29.8)
IV	9.8 (11.7)	3.5 (3.5)	7.5 (9.7)	8.3 (10.8)	— (2.5)	— (38.2)
Pa	3.6 (3.5)	1.8 (1.4)	2.2 (1.6)	— —	3.4 (4.0)	11.0 (10.5)



FIGURES 16–18. *Pediana horni* (Hogg). 16 & 17, right palpal tibia and tarsus of male SAMA N1988458 (reversed drawing): 16, ventral; 17, retrolateral. 18, vulva of female SAMA N1988462, dorsal. Scale line 0.5 mm.

same locality but 22°20′S, 124°45′E, WAM 88/1485; 1 ♀, Lower Carawine Gorge, 21°29′S, 121°02′E, WAM 88/1485; 1 ♀, Mundabullagana Station, 20°31′S, 118°04′E, SAMA N1988468; 1 ♀, Windy Corner, 23°34′S, 125° 12′E, WAM 88/2905; 1 ♀, Wittenoom, 22°14′S, 118°20′E, WAM 88/1493; 1 ♀, Woodstock Station, 21°37′S, 118°57′E, WAM 88/2133; 1 ♀, same locality but 21°36′ 34″S, 118°58′ 28″E, WAM 88/2533; 1 ♂, same locality but 21°36′ 40″S, 119°02′ 23″E, WAM 88/2132; 1 ♂, same locality, WAM 88/2133. **Northern Territory:** 1 ♀, Alice Springs, 23°42′S, 133°52′E, NTM A52; 1 ♀, Frewena Road House, 19°25′S, 135°24′E, NTM; 1 ♀, Hermannsburg, 23°57′S, 132°46′E, SAMA N1988465; 1 ♂, Idracowra Station, 25°00′S, 133°47′E, SAMA N1988464; 1 ♀, Ligertwood Cliffs, 23°39′S, 129°30′E, WAM 88/1494. **Queensland:** 1 ♀, Ambathala, 25°58′S, 145°19′E, QM S7174; 1 ♀, same locality, QM S7176; 1 ♀, same locality, QM S7219; 1 ♀, same locality, QM S7220; 2 ♀♀, Betoota (45 km E of), *ca* 25°45′S, 141°10′E, QM S7183; Eggsac and first instars, same locality, QM S7218; 1 ♂, Charleville, 26°24′S, 146°15′E, QM S7221; 1 ♀, Dunraven Station, 20°28′S, 143°57′E, QM S7180; 1 ♀, Lake Muncoonie, 25°12′S, 138°40′E, QM S7182; 2 juv. same locality, QM S7178; 1 juv. same locality, QM S7181; 1 ♀, Longreach, 23°27′S, 144°15′E, QM S7179; 1 ♀, Montara Bore, Sandringham Stn, 23°56′S, 138°47′E, AM KS15282; 1 ♀, Mt Munro, 22°13′ 50′′S, 142°28′ 50 ′′E, QM S7175; 1 ♀, Split Rock, Camooweal, 19°54′S, 138°39′E, AM KS20200; 1 ♀, Winton, 22°23′S, 143°02′E, QM S7177. **New South Wales:** 2 ♀♀, Springs Creek, 31°43′S, 142°41′E, SAMA N1988466-7.

Pediana tenuis Hogg
(Figs 19-22, Table 4)

Pediana tenuis Hogg, 1903: 462. Simon, 1908: 441. Holotype female, dried specimen, Western Australia [BMNH] lost.

Diagnosis

P. tenuis can be distinguished from *P. horni* by the presence of reddish setae in place of white on the anterior femora pro-ventrally. Males with relatively longer, thinner legs and straight-edged, triangular-shaped apex on dorsal basal ridge of palp tibial apophysis.

Female WAM 88/958

CL 8.5, CW 7.4. AL 16.9, AW 9.5.

Colour in alcohol: Similar to *P. horni* but carapace dark red-brown with more white than yellow setae. Black setae may be more numerous. Dark blackish-brown setae on sternum. Coxae orange-brown, prolaterally black-brown. Legs reddish-brown, dark brown-black patches. Femora retro-dorsally blackish occasionally forming a dark stripe. Clumps of reddish setae pro-ventrally on anterior pairs, whitish setae in clumps on posterior pairs. Abdomen green-grey with a black median streak and black spots formed of setae. Ventrally with orange setae.

Eyes: AME diameter 0.54. AME:ALE:PME:PLE = 1: 1.33: 0.93: 1.04. Interspaces; AME-AME 0.41, AME-ALE 0.15, PME-PME 1.11, PME-PLE 1.48, AME-PME 1.55, ALE-PLE 1.30. MOQ, anterior width: posterior width: length = 2.41: 2.91: 3.15. Clypeus more than half diameter of AME. Chelicerae: Retrolateral teeth 3. Labium: L 1.3, W 1.6. Sternum: L 3.9, W 3.3.

Legs (Table 3): Anterior leg ratio = 3.7.

Epigynum similar to *horni* but fossa relatively narrower posteriorly.

Male WAM 88/957

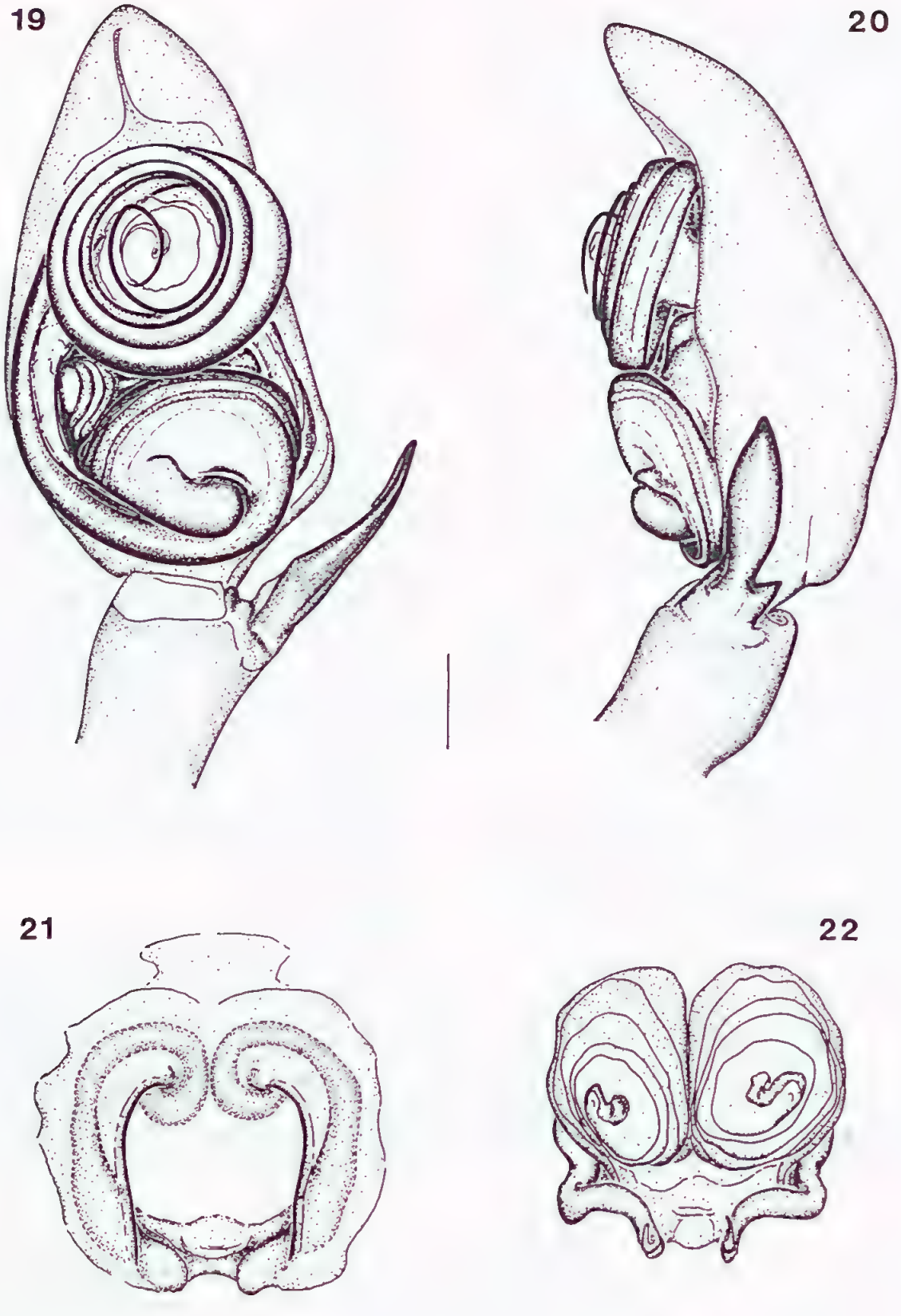
CL 7.3, CW 6.5. AL 9.0, AW 4.5.

Colour in alcohol: Paler than female. Venter of abdomen with smaller faint brown patches behind epigastric furrow and anterior to spinnerets.

Eyes: AME diameter 0.50. AME:ALE:PME:PLE = 1:1.24:0.90:1.00. Interspaces; AME-AME 0.24, AME-ALE 0.04, PME-PME 0.96, PME-PLE 1.24, AME-PME 1.56, ALE-PLE 1.00. MOQ, anterior width: posterior width: length = 2.24: 2.76: 3.20.

TABLE 4. Leg measurements of *Pediana tenuis* Hogg, female WAM 88/958 with male WAM 88/957 in parentheses.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	9.4 (12.9)	3.9 (4.2)	7.8 (12.1)	8.1 (12.6)	2.2 (2.9)	31.4 (44.7)
II	9.5 (12.9)	3.8 (4.2)	7.9 (12.0)	8.0 (12.7)	2.2 (2.9)	31.4 (44.7)
III	7.0 (9.1)	3.1 (3.0)	5.8 (7.9)	5.0 (7.3)	1.9 (2.1)	22.8 (29.4)
IV	9.2 (12.1)	3.1 (3.0)	7.0 (10.0)	7.8 (11.9)	2.2 (2.6)	29.3 (39.6)
Pa	3.1 (3.1)	1.6 (1.3)	1.8 (1.5)	— —	3.1 (3.3)	9.6 (9.2)



FIGURES 19–22. *Pediana tenuis* Hogg. 19 & 20, left palpal tibia and tarsus of male WAM 88/957: 19, ventral; 20, retrolateral. 21 & 22, vulva of female WAM 88/958: 21, ventral; 22, dorsal. Scale line 0.5 mm.

Clypeus half width of AME. Chelicerae: Retrolateral teeth 3. Labium: L 1.1, W 1.2. Sternum: L 3.4, W 2.8.

Legs (Table 4): Anterior leg ratio = 6.1. Tibial index (leg I) = 7.4.

Palps: Triangular-shaped dorsal basal ridge on tibial apophysis. Embolus with 5 coils. Median apophysis smaller than in *horni*.

Variation

Carapace lengths of females range from 6.6–10.5 (n = 11, mean = 8.8). Males; 6.6–7.3 (n = 3, mean = 7.0). Tibial index of leg I of males; 7.4–9.2 (n = 3, mean = 9.7). Epigynum parallel-sided and, as in *horni*, often slightly wider or narrower towards posterior but several specimens of *tenuis* examined are considerably narrower posteriorly (Fig. 21).

Comments

As this species is recognisable from Hogg's description, designation of a neotype is unnecessary.

Material examined

Western Australia: 1 ♂, Banjiwarn, 27°48′05″S., 121°40′05″E., WAM 88/957; 1 P♂, Charles Knob, 25°03′S., 124°59′E., WAM 88/1486; 1 ♀, Coordewandy, 25°36′S., 115°58′E., WAM 88/1487; 1 ♀, Gill Pinnacle, 24°54′S., 128°46′E., SAMA N1988469; 1 ♀, Goongarrie, 29°55′25″S., 121°14′35″E., WAM 88/958; 1 ♀, Lyndon Station, 23°38′S, 15°14′E, WAM 88/1488; 1 ♀, Messengers Patch, 28°41′S, 116°57′E, WAM 88/1489; 2 ♂♂, Thevenard Island, 21°28′S, 114°59′E, WAM 88/2012-3; 1 ♀, Warburton Ranges, 26°06′S, 126°39′E, WAM 88/1490; 1 ♀, same locality, SAMA N1988470; 2 juv. same locality but N.W. of, 25°10′S, 124°40′E, WAM 88/1491-2; 1 ♀, Yuinmery, 28°32′00″S, 119°05′45″E, WAM 88/2110. **South Australia:** 1 ♀, Flat Rock Hole, Everard Ranges, 27°06′S, 132°26′E, SAMA N1985179; 1 ♀, Lake Phillipson, 29°28′S, 134°27′E, SAMA N1988460; 1 ♀, Wynbring, 30°34′S, 133°32′E, SAMA N1988459.

Subfamily placement

Pediana was originally placed by Simon (1897) in his Heteropodeae (= Heteropodinae) on the criteria of its longer than broad ocular quadrangle. Hogg (1903) included it in his Deleneae (= Deleninae) with other Australian genera based largely on male genitalia structure. Simon (1903) enlarged the Deleninae subfamily, including many more genera. Jarvi (1914) restricted the Deleninae again to Australian genera but Petrunkevitch (1928) included the subfamily in the Eusparassinae Jarvi, 1912. Gravelly (1931) recognised the Deleninae but also included genera from both Petrunkevitch's Eusparassinae and Micrommatinae (Jarvi 1912). Finally, Hirst (1989) restricted the genera of Deleninae to those originally included by Hogg, one of which was *Pediana*.

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A LIST OF AUSTRALIAN ACANTHOCEPHALA AND THEIR HOSTS

S. J. EDMONDS

EDMONDS, S. J. 1989. A list of Australian Acanthocephala and their hosts. *Rec. S. Aust. Mus.* 23(2): 127–133.

A list of Acanthocephala known from Australia and their hosts is given and records are included.

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Manuscript received 8 February 1989.

Although during the 1980s two checklists were published that contained references to Australian Acanthocephala, one (Beumer *et al.* 1982) on the parasites of Australian fishes and the other (Mawson *et al.* 1986) on the parasites of Australian birds, no complete list of parasites and hosts of Australian Acanthocephala has appeared since that of Johnston & Deland (1929). In the meantime new species have been described, new records published and changes made to the systematics and nomenclature of the phylum. The aim of the present paper is to bring up to date as far as is possible information about the Australian species.

The scheme of classification followed is that outlined by Amin (1985), which is based on the Meyer-Van Cleave taxa, Archiacanthocephala, Palaeacanthocephala and Eoacanthocephala.

Specimens of many of the species are to be found in the Australian Helminthological Collection, now housed in the South Australian Museum, Adelaide, South Australia. The location of some type material is given in Smales (1983).

The following abbreviations are used in the paper; N.S.W. (New South Wales), Q. (Queensland), V. (Victoria), T. (Tasmania), S.A. (South Australia), W.A. (Western Australia), N.T. (Northern Territory).

Parasites and Hosts

Class ARCHIACANTHOCEPHALA

Gigantorhynchidae

1. *Mediorhynchus alecturae* (Johnston & Edmonds, 1947)

Echinorhynchus (Gigantorhynchus) sp. Johnston, 1912a: 106; Johnston & Deland, 1929a: 148.
Empodius alecturae Johnston & Edmonds, 1947b: 557–561, figs 11–21.
Mediorhynchus alecturae: Golvan, 1962: 29; Byrd & Kellogg, 1971: 137–142.
Host: *Alectura lathami* Gray.
Locality: Q.

2. *Mediorhynchus corcoracis* (Johnston & Edmonds, 1951)

Echinorhynchus sp. Johnston & Deland, 1929a: 151.
Mediorhynchus corcoracis Johnston & Edmonds, 1951: 1–3, Figs 2–9; Yamaguti, 1963: 117.
Hosts: *Corcorax melanorhamphos* (Vieillot), *Corvus tasmanicus* Mathews, *Corvus mellori* Mathews, *Corvus bennetti* North.
Localities: N.T., Q., N.S.W., V., T., S.A.

Moniliformidae

3. *Moniliformis moniliformis* (Bremser, 1811)

Echinorhynchus moniliformis Bremser, 1811: 1–31.
Moniliformis moniliformis: Travassos, 1915: 377: Johnston, 1909: 583; 1912b: 83; Southwell & Macfie, 1925: 171; Johnston & Deland, 1929a: 147.
Moniliformis dubius: Johnston & Edmonds, 1952: 20–21, Figs 8–9; Amin, 1985: 33.
Hosts: *Rattus rattus* (Linnaeus), *R. norvegicus* (Berkenhout), *R. fuscipes* (Waterhouse).
Localities: Q., N.T., N.S.W., S.A.

4. *Australiformis semoni* (Linstow, 1898)

Echinorhynchus semoni Linstow, 1898: 468.
Moniliformis semoni: Johnston & Edmonds, 1952: 18–20, Figs 10–17; Yamaguti, 1963: 132.
Australiformis semoni: Schmidt & Edmonds, 1989: 215–217.
Hosts: *Isoodon obesulus* (Shaw), *I. macrourus* (Gould), *Perameles gunni* Gray, *P. nasuta* Geoffroy.
Localities: Q., N.S.W., V., T.

Oligacanthorhynchidae

5. *Macracanthorhynchus hirudinaceus* (Pallas, 1781)

Taenia hirudinaceus Pallas, 1781: 39.
Macracanthorhynchus hirudinaceus: Travassos, 1917: 1–61; Johnston & Deland, 1929a: 147; Yamaguti, 1963: 141.
Host: *Sus scrofa* Linnaeus.
Localities: Q., N.S.W., V., S.A.

6. *Oncicola pomatostomi* (Johnston & Cleland, 1912)

Echinorhynchus pomatostomi Johnston & Cleland, 1912: 111-114,, Figs 1-4; Johnston & Deland, 1929a: 149-151: Yamaguti, 1963: 139.
Oncicola sp. Banks, 1952: 108: Edmonds, 1957a: 79.
Oncicola pomatostomi: Schmidt, 1983: 379-399, Figs 1-6.

Intermediate host: not known.

Paratenic hosts: especially in the tissues of the neck of the following birds: *Turnix castanota* (Gould), *T. velox* (Gould), *Pedionomus torquatus* Gould, *Anthus novaeseelandiae* (Gmelin), *Lalage leucomela* (Vigors & Horsfield), *Zoothera dauma* (Latham), *Melanodryas cucullata (Latham), Microeca leucophaea (Latham), Oreoica gutturalis* (Vigors & Horsfield), *Cinclosoma castanotum* Gould, *C. cinnamoneum* Gould, *Pachycephala inornata* Gould, *P. rufiventris* (Latham), *Colluricincla harmonica* (Latham), *Pomatostomus temporalis* (Vigors & Horsfield), *P. superciliosus* (Vigors & Horsfield), *P. ruficeps* (Hartlaub), *Amytornis purnelli* Mathews, *Sericornis pyrrhopygius* (Vigors & Horsfield), *S. cautus* (Gould), *S. brunneus* (Gould), *S. fuliginosus* (Vigors & Horsfield), *Acanthiza chrysorrhea* (Quoy & Gaimard), *Aphelocephala leucopsis* (Gould), *Daphoenositta chrysoptera* (Latham), *Climacteris leucophaea* (Latham), *C. picumnis* Temminck, *C. melanura* Gould, *Anthochaera carunculata* (White), *Manorina flavigula* (Gould), *Lichenostomus virescens* (Viellot), *L. plumulus* (Gould), *Poephila cincta (Gould), Grallina cyanoleuca* (Latham), *Artamus superciliosus* (Gould), *Gymnorhina tibicen* (Latham).

Definitive hosts: feral cats (*Felis catus* Linnaeus), dingo (*Canis familiaris dingo* Blumenbach).

Localities: Q., N.S.W., S.A., W.A., V., N.T.

Class PALAEACANTHOCEPHALA

Arhythmacanthidae

7. *Heterosentis paraplagusiarum* (Nickol, 1972)

Arhythmacanthus paraplagusiarum Nickol, 1972: 778-780, Figs 1-5.
Heterosentis paraplagusiarum: Amin, 1985: 39.

Host: *Paraplagusia guttata* Macleay.

Locality: Q.

Diplosentidae

8. *Pararhadinorhynchus mugilis* Johnston & Edmonds, 1947

Pararhadinorhynchus mugilis Johnston & Edmonds, 1947a: 15-17, Figs 10-17; Edmonds, 1973: 21, Figs 6 & 7.

Host: *Mugil cephalus* Linnaeus.

Locality: S.A.

9. *Pararhadinorhynchus coorongensis* Edmonds, 1973

Pararhadinorhynchus coorongensis Edmonds, 1973: 19-21, Figs 1-5.

Host: *Aldrichetta forsteri* (Cuvier & Valenciennes).

Locality: S.A.

Echinorhynchidae

10. *Acanthocephalus criniae* Snow, 1971

Acanthocephalus criniae Snow, 1971: 145-149, Figs 1-5.

Hosts: *Crinia tasmaniensis* (Gunther), *C. signifera* Girard, *C. laevis* (Gunther).

Locality: T.

11. *Acanthocephalus hastae* Baylis, 1944

Echinorhynchus truttae: Southwell & Macfie, 1925: 180.
Echinorhynchus clavula: Southwell & Macfie, 1925: 180.
Acanthocephalus hastae Baylis, 1944: 463-466, Fig 1.

Host: *Pomadasys hasta* (Bloch).

Locality: Q.

12. *Pseudoacanthocephalus perthensis* Edmonds, 1971

Pseudocanthocephalus perthensis Edmonds, 1971: 55, Figs 1-5.

Hosts: *Litorei moorei* (Copeland), *Limnodynastes dorsalis* Gray.

Locality: W.A.

Hypoechinorhynchidae

13. *Hypoechinorhynchus alaeopis* Yamaguti, 1939

Hypoechinorhynchus alaeopis Yamaguti, 1939: 317-351: Johnston & Edmonds, 1947a: 13-15, Figs 1-9; Yamaguti, 1963: 56.

Host: *Callionymus calauropomus* Richardson, *Pseudolabrus tetricus* Richardson.

Locality: S.A.

Illiosentidae

14. *Tegorhynchus edmondsi* (Golvan, 1960)

Illiosentis furcatus: Edmonds, 1957b: 94-95, Figs 2 & 3.
Illiosentis edmondsi Golvan, 1960: 159; Golvan, 1969: 21.
Tegorhynchus edmondsi: Amin, 1985: 47.

Host: *Upenichthys porosus* (Cuvier & Valenciennes).

Locality: W.A.

15. *Telosentis australiensis* Edmonds, 1964

Telosentis australiensis Edmonds, 1964: 41-43, Figs 1-5.

Host: *Anguilla reinhardtii* Steindachner

Locality: Q.

Pomphorhynchidae

16. *Longicollum edmondsi* Golvan, 1969
Longicollum pagrosomi: Johnston & Edmonds, 1951: 1–3, Figs 2–9.
Longicollum edmondsi, Golvan, 1969: 321–322.
Host: *Acanthopagrus butcheri* (Monro).
Locality: Q., S.A.

Rhadinorhynchidae

17. *Australorhynchus tetramorphacanthus* Lebedev, 1967
Australorhynchus tetramorphacanthus Lebedev, 1967: 279–282, Figs 1–2.
Hosts: *Seriola grandis* Castelnau, *Trachurus novaezelandiae* Quoy & Gaimard, *Paratrigla papilio* Cuvier & Valenciennes.
Locality: Tasman Sea; Great Australian Bight.

18. *Gorgorhynchus celebesensis* (Yamaguti, 1954)
Rhadinorhynchus celebesensis Yamaguti, 1954: 407, Fig 1.
Gorgorhynchus celebesensis Golvan, 1969: 10; Hooper, 1983: 22.
Hosts: *Platycephalus bassensis* (Cuvier), *P. richardsoni* Castelnau, *P. fuscus* Cuvier, *P. arenarius* Ramsay & Ogilvy, *P. longispinis* Macleay.
Locality: N.S.W.

19. *Micracanthorhynchina hemirhamphi* Baylis, 1944
Micracanthocephalus hemirhamphi Baylis, 1944: 422–426, Fig. 1: Johnston & Edmonds, 1952: 17–18; Edmonds, 1957b: 96; Nickol, 1972: 778–780.
Host: *Reporhamphus melanochir* Cuvier & Valenciennes.
Localities: S.A., T.

20. *Paracanthorhynchus galaxiasus* Edmonds, 1967
Paracanthorhynchus galaxiasus Edmonds, 1967: 41–44, Figs 1–6.
Host: *Galaxias attenuatus* (Jenyns).
Locality: S.A.

21. *Sclerocollum robustum* (Edmonds, 1964)
Neogorgorhynchus robustus Edmonds, 1964: 43–45, Figs 6–9.
Sclerocollum robustum: Schmidt & Paperna, 1978: 846.
Host: *Siganus lineatus* (Cuvier & Valenciennes).
Locality: Q.

22. *Rhadinorhynchus bicircumspinus* Hooper, 1983
Rhadinorhynchus bicircumspinus Hooper, 1983: 23–26, Figs 8a–8c.
Host: *Platycephalus bassensis*: (Cuvier).
Locality: N.S.W.

23. *Rhadinorhynchus carangis* Yamaguti, 1939
Rhadinorhynchus carangis Yamaguti, 1939: 341.
Nipporhynchus carangis: Edmonds, 1982: 71–73, Figs 1–3: Amin, 1983: 51.
Host: *Trachinotus russelli* (Cuvier).
Locality: Q.

24. *Rhadinorhynchus johnstoni* Golvan, 1969
Rhadinorhynchus pristis: Johnston & Edmonds, 1947a: 17–19.
Rhadinorhynchus johnstoni Golvan, 1969: 73.
Host: *Thunnus thynnus maccoyi* (Castelnau).
Locality: S.A.

25. *Serrasentis sagittifer* (Linton 1889)
Echinorhynchus sagittifer, Linton 1889: 494.
Serrasentis socialis: Southwell & Macfie 1925, 160; Johnston & Deland, 1929a: 152.
Serrasentis sagittifer: Van Cleave, 1924: 326; Hooper, 1983: 21–22.
Paratenic hosts: *Platycephalus bassensis* (Cuvier), *P. arenarius* Ramsay & Ogilvy, *P. richardsoni* Castelnau, *P. fuscus*, Cuvier.
Locality: Q., N.S.W.

Centrorhynchidae

26. *Centrorhynchus asturinus* (Johnston, 1913)
Gigantorhynchus asturinus Johnston, 1913: 93.
Centrorhynchus asturinus (Johnston, 1918 : 215).
Echinorhynchus bazae Southwell & Macfie, 1925: 177–178.
Porrorchis falconis Johnston & Best, 1943: 229–230, Fig. 18.
Centrorhynchus falconis Yamaguti, 1963: 123.
Hosts: *Accipiter cirrhocephalus* (Vieillot), *A. fasciatus* (Vigors & Horsfield), *A. novaehollandiae* (Gmelin), *Aviceda subcristata* Gould, *Falco berigora* Vigors & Horsfield, *F. cenchroides* Vigors & Horsfield, *Circus approximans* Peales.
Localities: N.T., Q., N.S.W., V., S.A.

27. *Centrorhynchus bancrofti* (Johnston & Best, 1943)
Gordiorhynchus bancrofti Johnston & Best, 1943: 226–228, Figs 9–16.
Centrorhynchus bancrofti Yamaguti, 1963: 121.
Hosts: *Ninox novaeseelandiae* (Gmelin), *Ninox strenua* (Gould).
Localities: Q., N.S.W., S.A.

28. *Centrorhynchus horridus* (Linstow, 1897)
Echinorhynchus horridus Linstow, 1897: 281–291.
Centrorhynchus horridus: Meyer, 1932: 119–120; Johnston & Edmonds, 1948: 70.
Hosts: *Halcyon sancta* Vigors & Horsfield, *Dacelo novaeguineae* (Hermann).
Localities: Q., N.S.W.

Plagiorhynchidae

29. *Plagiorhynchus charadrii* (Yamaguti, 1939)
Prosthorhynchus charadrii: Yamaguti, 1939: 316–361; Johnston & Edmonds, 1947: 561–562, Figs 25–30.
Plagiorhynchus charadrii: Schmidt & Kuntz, 1966: 526.
Hosts: *Charadrius rubricollis* Gmelin, *C. ruficapillus* Temminck.
Localities: S.A., T.

30. *Plagiorhynchus menurae* (Johnston, 1912)
Echinorhynchus menurae: Johnston, 1912b: 83, Figs 39–40.
Prosthorhynchus menurae: Johnston & Best, 1943: 226, Figs 1–8.
Plagiorhynchus menurae: Schmidt & Kuntz, 1966: 521.
Host: *Menura novaehollandiae* Latham.
Localities: Q., V., N.S.W.

31. *Plagiorhynchus cylindraceus* (Goeze, 1782)
Echinorhynchus cylindraceus Goeze, 1782.
Prosthorhynchus cylindraceus: Yamaguti, 1963: 152; Edmonds, 1982: 72–74, Figs 4–5.
Plagiorhynchus cylindraceus: Schmidt & Kuntz, 1981, 597–598: Smales, 1988: 1062–1064.
Host: *Turdus merula* Linnaeus, *Acridotheres tristis* Linnaeus, *Hydromys chrysogaster* (Geoffroy), *Isoodon obesulus* (Shaw), *Perameles gunnii* (Gray).
Localities: V., T.

32. *Porrorchis hylae* (Johnston, 1914)
Echinorhynchus hylae Johnston, 1914: 83–84.
Echinorhynchus bulbocaudatus Southwell & Macfie, 1925: 178–179.
Gordiorhynchus hylae: Johnston & Edmonds, 1948: 74–76, Figs 10–20.
Pseudoporrorchis hylae: Edmonds, 1957a: 76–77.
Porrorchis hylae: Schmidt & Kuntz, 1967: 133–135, Figs 5–7.
Paratenic hosts: *Hyla spp.*, *Limnodynastes spp.*, *Bufo marinus.*
Definitive hosts: *Centropus phasianinus* (Latham), *Podargus strigoides* (Latham).
Localities: Q., N.T., S.A.

33. *Porrorchis hydromuris* (Edmonds, 1957)
Pseudoporrorchis hydromuris Edmonds, 1957a: 77–78, Figs 1–4.
Porrorchis hydromuris: Schmidt & Kuntz, 1967: 141.
Host: *Hydromys chrysogaster* Geoffroy.
Locality: Q.

34. *Sphaerechinorhynchus rotundocapitatus* (Johnston, 1912)
Echinorhynchus rotundocapitatus Johnston, 1912b: 83–84, Fig. 5.
Sphaerechinorhynchus rotundocapitatus Johnston & Deland, 1929b: 155–166, Figs 1–34.
Host: *Pseudechis porphyriacus* (Shaw), *Pseudechis guttatus* De Vis.
Localities: N.S.W., Q., V.

Polymorphidae

35. *Arhythmorhynchus johnstoni* Golvan, 1960
Arhythmorhynchus frassoni: Johnston & Edmonds, 1951: 3, Fig 1.
Arhythmorhynchus johnstoni Golvan, 1960: 384; Edmonds, 1971: 60, Fig. 10.
Host: *Numenius madagascariensis* (Linnaeus).
Locality: Q.

36. *Arhythmorhynchus limosae* Edmonds, 1971
Arhythmorhynchus limosae Edmonds, 1971: 58–60, Figs 11–15.
Host: *Limosa lapponica* (Linnaeus).
Locality: Q.

37. *Bolbosoma capitatum* (Linstow, 1880)
Echinorhynchus capitatus Linstow, 1880: 49–50.
Bolbosoma capitatum: Meyer, 1932: 89; Edmonds, 1957a: 78; Edmonds, 1987: 327.
Host: *Pseudorca crassidens* Owen.
Localities: S.A., W.A.

38. *Bolbosoma balaenae* (Gmelin, 1790)
Echinorhynchus balaenae Gmelin, 1790.
Bolbosoma balaenae: Meyer, 1932: 85; Amin, 1985: 60.
Bolbosoma porrigens: Meyer, 1932: 85; Johnston & Deland, 1929a: 147.
Host: *Megaptera nodosa* Bonnaterre.
Locality: N.S.W.

39. *Corynosoma australe* Johnston, 1937
Corynosoma australe Johnston, 1937: 13–16, Figs 8–12; Smales, 1986: 94–96, Figs 7–11, 23.
Host: *Neophoca cinerea* (Peron & Leseuer).
Locality: S.A.

40. *Corynosoma clavatum* Goss, 1940
Corynosoma clavatum Goss, 1940: 12–13, Figs 33–38; Johnston & Best, 1942: 250; Johnston & Edmonds, 1952: 16–17, Figs 1–3 Hooper, 1983: 29–30.
Paratenic hosts: *Platycephalus bassensis* (Cuvier), *P. fuscus* Cuvier, *P. arenarius* Ramsay & Ogilvy, *P. richardsoni* Castelnau, *P. longispinis* Macleay.
Definitive hosts: *Phalacrocorax varius* (Gmelin), *P. sulcirostris* (Brandt), *P. melanoleucos* (Viellot), *Leucocarbo fuscescens* (Viellot).
Localities: S.A., W.A., N.S.W.

41. *Corynosoma stanleyi* Smales, 1986
Corynosoma stanleyi Smales, 1986: 92–94, Figs 1–6, 21.
Host: *Hydromys chrysogaster* Geoffroy.
Locality: T., V.

42. *Polymorphus arctocephali* Smales, 1986
Polymorphus arctocephali Smales, 1986: 97–99, Figs 12–16, 24.
Host: *Arctocephalus pusillus doriferus* (Schreber).
Locality: V.

43. *Polymorphus biziurae* Johnston & Edmonds, 1948
Polymorphus biziurae Johnston & Edmonds, 1948: 71–74, Figs 1–9.
Intermediate Host: *Cherax destructor* Clark.
Definitive hosts: *Biziura lobata* (Shaw), *Pelicanus conspicillatus* Temminck, *Threskiornis aethiopica* (Latham), *Platalea flavipes* Gould.
Localities: S.A., T., N.S.W.

44. *Polymorphus cetaceus* (Johnston & Best, 1942)
Corynosoma cetaceum Johnston & Best, 1942: 250–252, Figs 1–10.
Polymorphus cetaceus: Schmidt & Dailey, 1971: 137.
Hosts: *Delphinis delphis* Linnaeus, *Tursiops truncatus* (Montague).
Locality: S.A.

Class EOACANTHOCEPHALA

Neoechinorhynchidae

45. *Neoechinorhynchus agilis* (Rudolphi, 1819)
Echinorhynchus agilis Rudolphi, 1819.
Neoechinorhynchus agilis: Van Cleave, 1919: 250; Yamaguti, 1963: 18; Edmonds, 1982: 75–76, Figs 7–8.
Hosts: *Crenimugil crenilabis* (Forskal), *Mugil cephalus* Linnaeus.
Locality: Q.

46. *Neoechinorhynchus aldrichettae* Edmonds, 1971
Neoechinorhynchus aldrichettae Edmonds, 1971: 55–58, Figs 6–9.
Host: *Aldrichetta forsteri* (Cuvier & Valenciennes).
Locality: S.A.

47. *Neoechinorhynchus magnus* Southwell & Macfie 1925
Neoechinorhynchus magnus Southwell & Macfie, 1925: 149.
Host: unknown fish.
Locality: Q.
The only record is that of 1925. Edmonds (1982: 74) re-examined the holotype and found it to be a defective specimen. He considered it a *species inquirenda.*

48. *Neoechinorhynchus tylosuri* Yamaguti, 1939
Neoechinorhychus tylosuri Yamaguti, 1939: 347: Edmonds, 1982: 74–75, Fig. 6.
Host: *Tylosurus sp.*
Locality: Q.

OTHER RECORDS

1. *Echinorhynchus gadi* Zoega was reported from 'haddock' in Queensland by Southwell & Macfie (1925: 179). Johnston & Deland (1929: 153) reported that *Gadus* does not occur in Australia and considered that the record 'should be omitted from the Australian list'.
2. Hall (1974) listed some birds from which the cysts of *Oncicola pomatostomi* had been obtained. The information is included in the list given on page 128.
3. The record of *Mediorhynchus garruli* given in Mawson *et al.* 1982 is doubtful. The record came from the Commonwealth Institute of Health, Sydney but no specimen was available for checking.

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'WHAT ABOUT SELF-DETERMINATION?' THE DAA AND ABORIGINAL DRINK REHABILITATION PROGRAMS

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SACKETT, L. 1989. 'What about self-determination?' The DAA and Aboriginal drink rehabilitation programs. *Rec. S. Aust. Mus.* 23(2): 135–145.

Focusing on Aboriginal drink rehabilitation programs in Adelaide, South Australia, this paper examines the two-edged nature of the self-determination/self-management policy. Blacks use it to construct claims and make demands. At the same time it serves the state. To assist groups and organisations, government allocates funds, but on a competitive basis. This creates and maintains divisions in the recipient Aboriginal population, leading to squabbling and 'politicking' between rival bodies. The infighting makes it appear as though Blacks are incapable of getting 'their act together'. Moreover, it establishes the conditions and justification for continued state intervention; Aborigines must be 'helped' until such time as they are able to operate unaided.

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One might be forgiven for thinking the twenty-one years since the 1967 Referendum mark the coming of age of Aboriginal–state relations in Australia. Certainly this is widely acclaimed and generally accepted as a period of tremendous change. It began with the Federal Government, backed by a huge majority of the country's citizenry, moving to assume overall responsibility for the well-being of the nation's indigenous population. Following this the 'hodge-podge' of assimilationist and integrationist policies and practices were scrapped, to be gradually replaced by a collection of more innovative, Welfare State initiatives. These include implementing Aboriginal legal aid programs, Aboriginal health organisations, special Aboriginal educational and training grants, Aboriginal housing projects, Land Rights, economic improvements and so forth.

Government maintains that its support of these measures has been and remains primarily assistive, aimed at counteracting the history of injustices and facilitating Aboriginal self-determination and self-management. The idea behind this strategy is that with the proper kind of aid, Aborigines, as individuals, organisations and entire communities, will be well-placed to make decisions on their own behalf about their future (*see* 'Aboriginal Affairs Background Notes: Aboriginal Self-Management' 1983). The days of outsiders intervening in and directing Aboriginal affairs supposedly are almost over. That they are not quite at an end stems, in part at least, from the fact that, as many Whites remark and many Blacks readily admit, group after group is riddled with gossip and rife with 'politicking'. As part of this there is divergence of thought and infighting concerning the direction people should take, the best road to travel and the most proficient driver. From the administrative viewpoint this lack of unity — this, as one government employee put it, 'manifestation of the Aborigines' inability to get their act together' — provides the rationale or justification for continued (allegedly reluctant) intervention by outsiders in Aboriginal affairs. Aborigines must be helped until such time as they overcome their differences and are in a position to cope on their own.

But is the policy in practice so benign and enabling? As researchers like Offe (1972) and Galper (1978) have observed, although it is undoubtedly the case that some recipients of government largesse would be even worse off than they are had the ameliorative steps not been taken, the moves themselves impose new problems. In Australia these arise from the fact that while the kind of aid currently provided does constitute a new surface configuration in the ongoing Aboriginal–state assemblage, the underlying structure of associations stands unaltered. Non-Aboriginal society in general and the state in particular, remain in control; the regulation of money having replaced oppressive laws and blatantly paternalistic treatment as the exclusive manipulative mechanism. In this, again as Galper has noted, the allocation of (limited) revenue on an essentially competitive basis i.e. the manner said to be the fairest (and most democratic), is by its very nature divisive.

This means that at the same moment government seeks to promote community it simultaneously generates discord and enmity. That is, the divisions and disputes are not pre-existing, surmountable, nuisances; rather they are creations of the overall developmental scheme (*see* Beckett 1987, Howard 1982, Sackett n.d.). So if Aboriginal people are in some sense inherently better off than they were (with somewhat more of the nation's wealth now flowing their way), their corresponding heightened dependence on state patronage militates against the possibility they may show the type of solidarity

which would cause the state to cease directing Aboriginal affairs. Simply put, Aborigines are caught in a vortex wherein what is perceived as a lack of unity and consequent inability to direct their own affairs, the product of previous unremitting government interference, 'necessitates' further intervention. Such a 'no-win' situation is clearly shown by the predicament faced by Nungas (Aboriginal people) working in drink rehabilitation programs in and around Adelaide, South Australia.

Background

The original inhabitants of what is now the Adelaide area were introduced to intoxicating beverages even before the official founding of the Colony of South Australia in 1836. Sealers, whalers and intending settlers are reported to have used alcohol in, among other things, their negotiations with Blacks — the aim frequently being to secure Aboriginal women as sexual partners. The establishment of Adelaide town brought about an increase in the incidence of such transactions (Berndt & Berndt 1951: 67). But if a number of individuals sought to profit in this manner, at least a few influential Europeans perceived both personal and social costs. These people soon began expressing concerns about what they interpreted as a conjunction of Aboriginal drinking and drunken disorder, prostitution, bothersome begging, unsightly fringe camps, and the like (*see* contemporary issues of the 'South Australian Gazette and Colonial Register'). This not only served to contribute to the most widespread and enduring of Aboriginal stereotypes, that of the Aborigine as a problem drinker, it also supplied a reason for the direct involvement of Whites in the lives of local Aborigines.

The authorities' initial and, as it happens, long-lasting reply was to, in 1837, impose a prohibition upon the supply of liquor to Aborigines (Gale 1972: 59). This was later coupled with a set of sanctions directed at those Black men and women found in possession of such liquor. Aborigines, both for their own good and for the well-being of society as a whole, needed to be controlled; in large part through being 'protected' from what were 'obviously' potentially deleterious items. Although these moves combined to form only one of the many types of discriminatory legislation levelled at Aborigines over the years, they neatly summarised the state of play between them and a number of colonial and post-colonial administrations. While the various licencing laws operated to confirm and reconfirm the European view of Aborigines as a people incapable (owing either to genetic or cultural factors) of handling alcohol (and, more generally, other products and features of European civilisation), they did little to stem the flow of the banned liquid (Berndt & Berndt 1951: 68; Millar & Leung 1971: 92). At the same time, the impediments, by denying Aborigines free access to a commodity widely, openly and routinely enjoyed by Europeans, not only marked and maintained a social distance between Whites and Blacks, they incensed the latter.

Eventually, in the immediate pre-World War II period, this less than effective approach was amended. Under the new arrangements South Australian Aborigines were offered inducements, the possibility of unrestricted access to alcohol among these, to modify certain of their behavioural patterns, abandon others and by-and-large adopt a Western-oriented life-style. Those judged to have passed muster were exempted from the provisions of the special acts, enabling them legally to enter precincts formerly exclusive to the non-Aboriginal community — especially the previously off-limits bars of public hotels. But just as prohibition and punishment had failed to halt Aboriginal drinking or resolve the 'problems' associated with Aboriginal alcohol consumption, so the selective granting of privileges was found wanting. In fact the alterations, rather than redressing the prevailing situation, further complicated matters. The relatively few Aborigines awarded 'citizenship' had many relatives who remained wards of the state — unable to purchase liquor[1]. These kin, rather than continue transacting in procuring and intercourse or paying exorbitant prices to Whites for illicit alcohol, began prevailing upon their more fortunate relatives to purchase it on their behalf. Needless to say, this frequently brought those with rights to the attention of the police and led to them spending periods in gaol[2].

Recently a succession of South Australian State Governments have moved to strike from the statutes all edicts recognised as disadvantaging Aboriginal people, including those covering liquor[3]. Surprisingly, this apparent change of course was not the product of (nor has it generated) a reassessment of the entrenched belief that Aborigines have a drink problem. On the contrary, for most Whites the present unobstructed availability and occasionally very public use of liquor by a portion of the Aboriginal community merely demonstrates that Blacks have yet to come to terms with drink. But if a 'problem' remains, its cause has been redefined; at least at the official level. For example, the Honourable Clyde Holding, when Federal Minister for Aboriginal Affairs, remarked that heavy drinking and drunkenness on the part of Aborigines must be regarded 'as the symptom of deeper problems', such as the 'effects of dispossession . . . the extreme disruption of Aboriginal society. . . . poor housing and low self-esteem'. We

need to attack these, he said, not 'opt for the easy solution, of blaming the victim' (1984: 11). Commonwealth and South Australian administrations not only have set out (in their own way) to do battle with the underlying causes, they have gone on to underwrite measures designed to help Black people overcome more immediate difficulties they may face with drink.

The Adelaide Aboriginal Drink Rehabilitation Arena

Subsidised and self-sustained treatment and support facilities for drinkers had operated for some time around Adelaide, as they had in other Australian cities. However, from the point of view of both Aborigines and White bureaucrats and social workers these all shared a critical shortcoming. None of them were particularly sympathetic to the needs of the minority Black population. Aborigines were said, and themselves claimed, to feel socially excluded in gatherings organised and attended almost exclusively by Whites ('Conference on "Drink Related" Problems Amongst Aboriginal People' 1975: Appendix A; Aboriginal Resources Division n.d.: 10). It was even suggested that Alcoholics Anonymous (AA), the Salvation Army and the like, with their continual references to and weighty reliance upon the Christian deity, were antithetical to Aboriginal culture, including that of urban Blacks. What was needed was 'Aboriginalisation', at the level of personnel *and* approach.

The first formal steps in this direction were taken in the latter half of 1972 by the South Australian Department for Community Welfare (DCW) when, with the strategy shift by Aboriginal Affairs and accompanying marked increase in the availability of funds, it sponsored a research project on 'Aboriginal alcoholism'[4]. The results of this investigation not only 'confirmed' that Blacks indeed were alienated from existing services, they highlighted the fact that one organisation — the Adelaide Central Mission (ACM) — indicated a willingness to 'adapt its programs to meet the needs of Aboriginal' people ('Conference on "Drink Related" Problems Amongst Aboriginal People' 1975: Appendix A). The ACM, with headquarters near the heart of the city, maintained a drop-in centre it called the Crypt, where street people could get out of the cold or rain, have a cup of coffee and, if so inclined, seek aid and advice from welfare workers. As this was the only place of its type, and because little reformist pressure was put on users, a large number of people, including a few Aborigines, passed through its doors. That some members of what had come to be designated as a shockingly needy section of Australia's most deserving group used a facility run by a body expressing a preparedness to address the special requirements of that group, led to the ACM quickly being singled out as a potential conduit for relief.

By the early months of 1973 the ACM, aided by government money, had employed an Aboriginal man who had just completed a nine-month stay at its recuperative colony in the Adelaide Hills. He, alone or in the company of an Aboriginal employee of the Prisoners' Aid Association, regularly visited the local gaol, parks and squares, encouraging people to abandon drink and their 'wasteful' drunken life-style. Additionally, these two, plus two non-Aborigines, one from the ACM and the other from the DCW, began devising a rehabilitation program they hoped would mesh with the Aboriginal socio-cultural system (Aboriginal Resources Division n.d.: 13). The expectation was that this would be tested and, where necessary, extended or transformed as other Aborigines who had been consumed by the the quest for liquor used it as a vehicle to 'attain sobriety'.

A promising extension of these Aboriginalisation efforts occurred later in 1973 when the reformed drinker from the ACM joined with a few other Nungas to begin the Aboriginal Sobriety Group (ASG). This body, modelled roughly on AA, first assembled wherever Aboriginal drinkers gathered. Later it came to hold regular weekly meetings at the Aboriginal Community Centre. At these the five, to ten, to twenty, or so in attendance would talk through their drink histories, discuss the devastating effects alcohol had had and was having on Aborigines' lives and Aboriginal culture, and mutually encourage one another to continue resisting the temptations of liquor (*see* Leary *et al.* 1975: 21; Coaby 1976: 96; Milera 1980: 15–18; Sumner 1984: 33).

Begun as an aspect of one campaign, the ASG, or a least a segment of the group, soon determined to go its own way. With the Government's new liberal approach offering a ripe opportunity to continue expanding the provisions and facilities for Aborigines 'interested in getting off the grog', some regulars sounded out or were sounded out (the details are unclear) by the authorities on the possibility of the ASG getting funds to open a hostel and institute a totally Aboriginal-controlled scheme. Having positive indications in hand, they put it to their fellow members that if drink rehabilitation was to be truly Aboriginalised, then (in line with both grassroots demands and public policy) Aborigines alone, not Whites and Aborigines, should be making all plans and decisions. That is, it was necessary to step beyond the essentially ACM-patronised frame. Further, the ASG should and could lead the way in this pursuit.

While this news proved popular with the majority, it perturbed those most closely associated with the ACM. The latter responded by both defending the involvement of whites and issuing warnings concerning what they claimed was the rhetoric of 'educated' Blacks (i.e. the kind of talk supposedly emanating from those supporting the proposition and said to be characteristic of people having little familiarity with, or little in common with, the bulk of Aboriginal people). When it became evident these rejoinders were falling on hostile ears, the ACM supporters departed.

The emergent rift between Aborigines linked to the ACM and those involved in the ASG, which at the time was attributed to simple personality clashes, caused immediate concern. There was a real worry that those confronting a pressing issue would end up bickering over methods, and thereby be diverted from their urgent task. Indeed, it was soon being said that the programs of the two organisations actually were working against one another ('Conference on "Drink Related" Problems Amongst Aboriginal People' 1975: 2 and Appendix A). This, plus the growth of rehabilitative developments in South Australian country areas, sparked calls for mediation. A report by the DCW Aboriginal Resources Division (undated, though produced during 1973–74), for instance, recommended the:

> development of an overall strategy for the treatment of Aboriginal alcoholism through the medium of a two day seminar attended by representatives from all bodies who have contact with Aboriginal alcoholics (n.d.: 32).

and

> the establishment of an 'Advisory Committee on Research into Aboriginal Alcoholism' to undertake and direct epidemiological, psychological, sociological and philosophical research, to offer direction to preventive and treatment orientated agencies in the development of programs, and to co-ordinate research material obtained from overseas and interstate programs (n.d.: 32).

The resulting convocation of December 1975 formed the Woma (said to mean 'bad drink') Committee, made up of, among others, representatives from the various Aboriginal drink rehabilitation programs operating throughout the state. The idea was that this overarching council would control the flow of funds from government to its constituent parties. It was expected this in turn would give the body the power to coordinate all Aboriginal drink rehabilitation activities and thereby prevent dissension and unnecessary duplication. Such a representative forum also would be ideally placed to marshal and proffer compelling arguments for additional funding, with the result that the entire endeavour would expand and evolve. Indeed, the Department of Aboriginal Affairs (DAA) representative bluntly stated that her organisation 'did not want to support individual groups but rather to see a unified and coordinated approach' ('Conference on "Drink Related" Problems Amongst Aboriginal People' 1975: 2).

Following its birth, the Committee quickly succeeded in gaining DAA support. This money went towards creating and maintaining the Woma Secretariat, a unit of four permanent staff whose purpose — in line with the aspirations behind Woma's origin — was twofold. On the one hand, it was to constitute an administrative centre, liaising between Government and the many rehabilitation operations, arranging Woma Committee meetings, taking minutes, distributing information, disbursing finances, and so forth. On the other hand, the Secretariat was to be something of a resource centre. It was to run surveys, evaluate programs, collate data, set up training schemes, make manpower suggestions etc. (*see S.A. Woma Newsletter* 1979: 8).

While Woma, through its Secretariat, did seek to function as a pressure group (Smith 1976: 108), it never became the granting and regulating body its founders envisaged. From the outset its annual funding only ever covered its own ongoing wages and travel expenses. Consequently, its employees were never able to intervene in the operations of the various rehabilitative efforts. That is, they could never execute many of the duties they had been hired to perform. They lacked the 'clout' to do so.

Having prodded people into fashioning Woma, the government of the day declined to assent to its funding scheme. It responded in this manner because it found itself caught in a bind as to how to proceed, not simply in the drink rehabilitation arena but in Aboriginal affairs more generally. Just as it wanted to be seen to be enabling Aboriginalisation it also had to appear responsible, especially in regard to its constituents' tax dollars. Granting money to organisations like Woma could be advertised as being in tune with the first objective; it also, as the state was discovering, could be interpreted as being out of harmony with the second. At the same time government was sponsoring the composition of Woma, it was coming under increasing criticism from non-Aborigines over the apparent lack of accounting procedures in its funding of Aboriginal projects. Stories of wastages and misappropriation were common (*see* Howard 1979: 11–12). To both rectify the situation and protect itself, the DAA implemented stringent guidelines about grant disbursements. These, among other things, endorsed direct funding procedures; which, when

put into practice, struck at the very fabric of those bodies (like Woma) that sought to be intermediate agents in the distribution process.

Furthermore, in the wake of Woma's emergence, questions concerning its pertinence were raised. Some of these were voiced by the medical director of the state's Alcohol and Drug Addicts Treatment Board (the Board). He argued that the creation of a (separate) management and instructional body for Aborigines was wasteful in that it duplicated services already offered elsewhere. More dangerously, such fragmentation (along racial lines) weakened what needed to be a strong, collaborative arrangement (*The Advertiser,* 31 January 1976: 17).

The criticisms aired initially by the Board's medical officer were amplified by other non-Aboriginal bureaucrats into a major attack. This for the most part focused in on an alleged disparity between Woma's role and its accomplishments. One report, for instance, noted that:

> the Adelaide Central Mission adopts a professional approach in providing an effective program of services (Oakes & Drew 1981: 29)

and

> the ASG provides an effective program of services (Oakes & Drew 1981: 28).

However, the report also indicated that Woma's personnel not only had been woefully unsuccessful in promoting inter-group communication, they lacked expertise in alcohol-related issues and, concomitantly, were neither qualified nor 'competent to objectively assess the relative needs' of the various programs (Oakes & Drew 1981: 33). In the end the document counselled that the 'Alcohol and Drug Addicts Treatment Board . . . would be the appropriate agency to undertake' the necessary tasks (1981: 35), and that such an arrangement 'would not require the continuation of the . . . State Woma Committee' (1981: 36).

This being the case, it is not surprising that in the years following the inauguration of Aboriginal drink (and drug) rehabilitation activities around Adelaide, ACM and ASG endeavours burgeoned while Woma withered. These divergent evolutionary lines can be seen immediately by examining funding levels of the three relative to one another. In 1977–78, the first period in which the three were all fully operational, ACM was granted $63 916 (44.5%), ASG $13 000 (9%) and Woma $66 849 (46.5%) of the $143 765 allocated to programs serving the metropolitan area. By 1983–84, the last time all three functioned, ACM received $106 265 (44.35%), ASG $71 940 (29.2%) and Woma $65 134 (26.45%) of the total of $246 339.

The ACM used its grants to employ five Aboriginal counsellors or welfare officers. They, along with about an equal number of non-Aboriginal workers, operated from a day-centre situated near one of Adelaide's most popular drinking squares. Besides having a presence in this square and the nearby parklands, attending the Adelaide Magistrates Court, and simply being on hand and visiting Aboriginal (and non-Aboriginal) men and women who came into the centre, the workers advised people who expressed an interest in 'sorting out their lives'. Where appropriate they made arrangements for people to go through an initial detoxification and on to either the Mission's colony in the Adelaide Hills or the Nunga Farm, a facility operated by the Lower Murray Nunga Club. In addition to maintaining contact with clients at these more distant locations, the workers sought to call on them in their homes when they eventually returned to the city.

The ASG, also on DAA money, was based in the Aboriginal Community Centre. From here a staff of five or six operated a soup kitchen, ran a recreation club for children, supervised involvement in Black netball and football teams and dealt with people who requested assistance. In accordance with the organisation's guiding philosophy, ASG personnel viewed themselves as a support group — not as providers of treatment. As such they continued to hold regular meetings. Furthermore, like the Aboriginal workers at the ACM, ASG employees helped people gain entry to detoxification and more lengthy rehabilitation programs. The group also, in conjunction with Aboriginal Hostels Ltd, maintained three residences: an overnight shelter for people 'still on the grog' and two 'dry' houses (one for men and one for women) for those learning how to live without alcohol (*cf.* Sumner 1984).

The Woma Secretariat was also situated in the Community Centre. In contrast to ACM and ASG staff, however, the two Woma employees toiled virtually full-time on administration, leaving the office only to visit government departments, attend meetings etc. Their complete lack of contact with drinkers exposed them to criticism from those workers who saw themselves as existing on the extremely wearing and frequently very messy front line of welfare assistance. This Aboriginal censure of Woma ultimately was wielded with telling effect by government.

'Self-Determination' In The Drink Rehabilitation Arena

While the authors of the growing body of published and unpublished observations critical of

the role and operation of Woma and its Secretariat, canvassed Aboriginal views on the organisation, these were neither reported nor used to support conclusions and recommendations[5]. Rather, the findings cited 'objective' factors such as a supposed lack of paper qualifications of staff and an overall poor cost effectiveness of the unit. Perhaps they proceeded as they did because Aboriginal disapprobation of Woma, like the remarks ACM and ASG members were said to have made about each other earlier, ordinarily were couched in terms of what was regarded as personalities, not in terms of structures or operational issues (*cf.* Beckett 1987: 200). Those in or associated with the different programs regularly indicated to one another, to DAA personnel, to investigators and interested outsiders, that the capacities of the Woma retinue should at best be regarded as a joke. A more serious critique was that funds directed towards the Secretariat were being totally squandered; they were not being invested so as to produce any conceivable return. The Secretariat was supposed to be 'an umbrella, covering all organizations'. But the various sub-structures 'remain[ed] quite independent'. It was asserted the people on the Secretariat 'dressed real sharp, worked behind their desks from eight to five and never ventured near the squares or pubs'. One Nunga put it in a nutshell when he said they were 'underemployed, sitting around doing a little bit of paper work', while ACM and ASG were 'crying out for help' (i.e. in urgent need of additional staff).

Whatever the case, the absence of any obvious Aboriginal input into the bureaucratically-originated deprecations of Woma allowed Blacks to argue that such criticisms failed to reflect their views. Thus, to follow any suggestions embodied in the appraisals would weaken the new powers of self-determination. This claim permitted people to resist any endeavours to place Aboriginal drink rehabilitation activities under the authority of the Board. Such a move, they said, would be a retrograde one. It would both go against the notion of Aboriginalisation and eat into what was accepted as recently gained autonomy.

This stalemate continued through to mid-1983, when the DAA commissioned yet another examination of all Woma operations. Personnel from the ACM and ASG later claimed they had requested something along these lines. The DAA, with a long list of complaints from Aborigines concerning Woma, could be interpreted as (and actually indicated it was) responding to Aboriginal demands. The investigator, a non-Aboriginal woman working for the Board, started from the conclusions Oakes & Drew (*op. cit.*) had reached two years earlier: that the Woma Committee (and Secretariat) be disbanded and the Board take over both the training of Aboriginal workers and coordination of the various Aboriginal drink rehabilitation exercises. She (Walsh 1983, 1984), like researchers before her, discovered that Aborigines involved in drink rehabilitation activities from throughout the state were deriding Woma. Moreover, she included some of their remarks in her report. She quoted people as being against the body because '[t]he Chairman lived too far away'; 'the State Committee didn't meet enough'; and it 'acted as boss, not an employee' (Walsh 1984: 17). In a similar vein she noted that people alleged they had 'lost faith in the Secretariat'; that 'personality reasons led communities to separate from the Secretariat'; and it needed 'to be restaffed' (Walsh 1984: 19). At the same time interviewees were said to be very much in favour of some type of program of formal vocational education. As one person declared, '[t]raining is a must . . .' (Walsh 1983: 5). The support for a proposed teaching unit was completely consistent with the criticism of Woma. This was precisely the area where Woma reputedly had let rehabilitation workers down[6].

Curiously, although Walsh highlighted Aboriginal gibes at Woma, such sniping was by no means directed exclusively at the Secretariat, nor was it confined to drink rehabilitation endeavours. On the contrary, it radiated out to include the DAA, Aboriginal Legal Aid, the Aboriginal Task Force, Offenders Aid and Rehabilitation Service, the Department of Social Security, and so on. It was simply particularly concentrated within the drink rehabilitation arena. For example, it was said the ACM Aborigines really had no consolidated campaign. Sure, they were seen around the parks, but what else did they do? The view was that they (depending on the exigencies of available 'bed' space instead of individual needs) sent clients here and there, did not run a support group for ex-drinkers, and so forth. It was held that they actually were constrained from doing much that was 'constructive'. The DAA granted money to the ACM, basically a White-run organisation. Even the most senior of the Aboriginal staff worked under and took orders from a White; to the extent that Aborigines supposedly had to seek permission from non-Aborigines to use a car purchased with DAA funds. Worse yet, the ACM was, when all was said and done, a Christian mission. As one observer noted, re-calling memories from the recent history of Black-White relations, such organisations strived towards White goals and served to maintain Aborigines as subservient. At least one exhortation was that the DAA must not even consider sustaining so compromised a group, but should divert all money going to the ACM to the ASG, 'where Aborigines would control it and derive some benefit from it'.

The ASG, for reasons not unlike those put forward in conjunction with the ACM, also was said to lack a coherent program. Indeed, it was alleged that sometimes, instead of coping with problems, ASG members rang the Aboriginal staff at the ACM for advice and assistance. In addition, ASG members were labelled 'secretive', 'nepotistic' and 'uncooperative'. However, the most persistent and damning indictment revolved around ASG's alleged lack of prominence in the community. Comments were that, 'You just don't see them around', and that they spend all (or at least too much of) their time 'sitting in the office, waiting for people to come to them'. The result, it was suggested, was that street people had little or no knowledge of ASG facilities. Why did ASG workers ensconce themselves in this manner? The reply was that they were more interested in 'empire building than in the people they [we]re supposed to be dealing with and serving'. They saw 'their job simply as trying to get more money'. Consequently, they needed 'looking into' i.e. funds earmarked for ASG would be better spent elsewhere.

Although the comments reported by Walsh consistently scorned Woma, they were more discordant when it came to prescriptions for change. Some were noted as favouring the remoulding or reconstituting of Woma in such a way as to overcome past problems and meet emergent needs (Walsh 1984: 5). This would allow groups to remain independent (as they had become 'under' Woma), both of overarching authority structures and of one another, and to decide their own further education. Others advocated placing the various groups within the folds of a larger fabric, like the Board or the Aboriginal Health Organisation, which would oversee activities and schooling (Walsh 1984: 5). It was also claimed that those holding the latter type of view were under extreme pressure from people maintaining the former position to step beyond their limiting stance and join in opposing retrograde action (Walsh 1984: 7–8). Such findings permitted the investigator to recommend that:

> . . . the present State Committee structure no longer continue in its present form and employees of the Woma Secretariat be found alternative employment . . . (Walsh 1984: i).

Additionally she recommended:

> . . . that the Aboriginal proposal for an independent Training and Resource Unit for the education of Aboriginal alcohol workers be accepted and achieved over a three year period (Walsh 1984: i).

But she proposed:

> . . . that the Alcohol and Drug Addicts Treatment Board be contracted to employ and administer an interim education team to oversee the three year *transition* to independence (Walsh 1984: i).

Remarkably, it was some months before Aborigines from the ACM, ASG and Woma Secretariat were allowed to see the completed document. A staff member of the Secretariat indicated that her repeated requests to DAA for a copy of the so-called Walsh report consistently had been met with the same reply: that the recommendations were still being considered and in any event the drink rehabilitation people knew its contents as it was based on their views and ideas. Needless to say, this secrecy operated to make the findings the subject of intense speculation. It also aggravated the level of bitterness between groups. During the long period of uncertainty, people, using the tools of invective and innuendo, sought to ensure that they were immune to criticism — through doubly disparaging the labours of others. However, at the same time the fissures between groups were being deepened, a consensus of betrayal developed. It was asserted that the report had been 'commissioned by the community' i.e. requested by Aboriginal people directly involved in drink rehabilitation programs, but instead of being presented to community representatives had been (wrongly) sent to the DAA.

When the review eventually was released in July 1984 it got a swift and sour reception — from ACM and ASG workers as well as Woma staff. Representatives from each of these bodies quickly gathered to discuss the report's features and implications. Those at the centre of the turmoil, continuing a strategy adopted some years previously, attributed their many difficulties to government miserliness. They claimed they always had been hamstrung by government funding arrangements. These not only prevented the Committee and its Secretariat from doing what they were supposed to do, they placed 'Aboriginal people and communities in the position where by (*sic*) they [we]re divided by the decisions of the Dept. of Aboriginal Affairs' (letter from the President of the Woma Committee to the Federal Minister of Aboriginal Affairs, 7 November 1980; *see* also *Advertiser* 9 May 1981: 3). At least some ACM and ASG employees agreed that the DAA, through its financial and other policies, sought to 'divide and rule'. Significantly, all in attendance concluded that many of the Walsh report's findings were 'ridiculous and totally unsupported by data'. The Woma spokesperson adopted this line in an attempt to save the body of which she was a part. The ACM and ASG functionaries joined in; though they were not

so much concerned with the continuance of Woma as they were with preserving their own independence. The solid rejoinder was that the Walsh report reflected not the views of Aborigines and Aboriginal workers but rather those of White bureaucrats and the non-Aboriginal author. It was maintained that the inquiry should have been carried out by an Aboriginal person knowledgeable in the problems of drink rehabilitation. This being the case, those present resolved to appeal to the DAA to discuss the situation at an emergency meeting of the Woma Committee.

Personnel from the DAA foresaw little profit, either for themselves or the Aborigines concerned, in such a meeting. It was declared that the 'uproar' was groundless. Although 'people from the community' were claiming their position was not truly represented, as was 'amply demonstrated' in the report itself, they had been consulted. For years they had complained about Woma. Now that these complaints were being taken seriously they began raising objections. The DAA, it seemed, had decided to act in line with the report's recommendations — at least as far as these related to the dismembering of Woma and locating programs under the aegis of the Board.

For a time the Aboriginal workers confined themselves to lobbying against the mooted 'takeover'. When their efforts to move DAA officials failed they proceeded to more concerted action. In late September 1984, they convened a two-day conference of the Woma Committee. The first day of this was spent venting anger and debating plans of action. Were the Secretariat's days really numbered? If so, should they allow the ACM, ASG and others, to become part of the Board, or should they seek to be merged with the Aboriginal Health Organisation? What consequences would these and other possible arrangements have for local autonomy? These discussions proceeded in something of a vacuum, however. No one from the DAA was on hand — to state the department's position, comment on options being screened, indicate funding potentials etc. This perceived slight produced further consternation. So much so that a number of those present argued that all in attendance should march on the offices of the DAA and 'demand an accounting'. In the end this prospect, conveyed by telephone to the DAA, was enough to win the pledge of government representation on the following day.

The second session began with the promised emissary telling the meeting that his department, acting upon complaints and recommendations with which everyone was familiar, had resolved that 'as of 30 September the Secretariat's funding stops'. Following this brief announcement the floor was opened to questions, not discussion. The decision had been made. The Woma Committee could not change this; although its members were free to ask how this would effect their respective programs. The immediate and only question raised was 'what about self-determination?' In elaboration it was charged that the judgement had been made not by 'the Aboriginal people', but rather 'from on high' and then passed down to Aborigines. The DAA employee did not respond to this. As he departed people bemoaned what they saw as the injustice of the situation.

What about Self-Determination?

In the hours, days and weeks following the dissolution of the Secretariat, people volunteered a range of explanations for its fate. As might be expected, these for the most part homed in on personality factors. That the people involved were unable to see or escape the fetters of the configuration in which they were embedded, and ended up 'throwing verbal rocks at one another', merely lent support to the notion that Aborigines were incapable of sorting out their differences and getting on with the job of dealing with the drink problem faced by their fellows.

No doubt it would be possible to analyse the backbiting by Nungas embroiled in the Adelaide drink rehabilitation arena in much the same way as Colson (1953) and Gluckman (1963) viewed material on gossip and scandal among the Makah Indians. Like the Makah, the Nungas operated within a context of dispossession and subjugation. Further, they too had endured heavy and sustained pressure to abandon their socio-cultural system and to conform with the beliefs and practices of the colonial and post-colonial societies in which they came to be located. And, as with the Makah, where we might expect that people 'would array themselves in unity in order to maintain their independence and identity', they ended up being 'torn by internal dissension' (Gluckman 1963: 310). But, in line with Colson and Gluckman, it could be argued that the internal strife experienced by the original Australians was (as it was for the indigenous Americans) neither as divisive nor as detrimental as first appearances would indicate. On the contrary, shared knowledge of the existence and use of disparaging comments in itself served to define and unite Aborigines. To be a member of the group one 'must be able to join in the gossip' (Gluckman 1963: 311) of that group. Conversely, outsiders could not and were not allowed to participate in the gossip network. Thus those who gossiped with and about one another constituted a cohesive unit.

However, to assess the material in this manner would be to examine it in a one-eyed fashion. It would be to discover and attribute to gossip

'important positive virtues' (Gluckman 1963: 308), and promptly rest one's case. Clearly, it is essential that we also gauge the effects and implications of extra-group factors — especially when investigating the situation of Fourth World peoples. That is, we must consider how backbiting may be generated *and* manipulated by outsiders. For if personal attacks and counter-attacks mark off and link group members in some way, they simultaneously result in people being pitted against one another — quite possibly to their collective detriment. External aspects are evident in the Makah data in the form of the state-legislated economic benefits which flowed to group members. Basically it was a case of people striving, in large part *via* the manifold mechanisms of gossip, to keep their numbers low, in order to maximise individual shares of revenue (*see* Gluckman 1963: 310). The Nunga case contains parallel associations between scandalmongering and competition for access to slices of a derived monetary 'pie'.

Year after year the ACM, ASG, Woma and other Aboriginal drink rehabilitation units throughout South Australia had to approach the DAA for funds to continue. As time went on, it became generally accepted, whether accurately or not, that money earmarked for rehabilitation exercises was extremely limited. In these circumstances each organisation came to regard its ability to maintain or increase its respective enterprise as dependent upon, on the one hand, the positive claims it might make for itself and, on the other hand, anything negative it might succeed in having accepted about its rivals. This two-pronged approach was particularly appropriate as none of the bodies found it possible to 'demonstrate success' in their rehabilitative efforts. Unlike Aboriginal Housing Associations, which were able to cite the purchase or construction of dwellings and consequent sheltering of Aboriginal families; Aboriginal employment schemes, which could boast about enhanced job skills and reduced unemployment figures; or even Legal Aid services, which were able to submit statistics on the way they had been instrumental in securing the 'basic human rights of Aborigines'; Aboriginal drink rehabilitation programs were unable to show that their endeavours got and kept Aborigines 'off the grog'[7]. The best they could do was to cite evidence of heavy involvement with inebriates. The ACM, for instance, required its workers to keep track of the number and type of contacts they had with clients (i.e. by storing luggage, assisting in providing medical attention, formal counselling). Similarly, ASG maintained records on the calls it made, on the travel assistance it offered, the meals it supplied, and the occupancy rates at its hostel facilities.

But providing services to people is not the same as bringing about their rehabilitation. The inability of the various drink programs to be specific about how many people they had encouraged and enabled to 'kick' the alcohol habit, let alone the inability of any single organisation to establish that it was a more efficient and competent rehabilitator than its adversaries, did not dampen competition, it inflamed it. As Galper notes:

> In the absence of objective means for setting priorities, the planning mechanisms for resource distribution establish a set of rules which govern interest-group competition. Money goes to those groups best able to compete in the political arena (1978: 15).

In this sphere ACM, ASG and Woma routinely accused one another and in turn were each accused of not deserving the funds they received. Over and over the message was one of wastages (by others), needs (of the Aboriginal community) going unmet and the like. By and large the 'brick bats' made up and thrown at ACM and ASG staff struck and helped define what seemed to be diacritic features of the two organisations. The one, in conformity with missionary traditions, appeared to proselytise while the other, in accordance with Aboriginal notions of both the acceptance of the life-styles of others and generalised hospitality, operated something of an open house. But while people questioned ACM and ASG tactics, they, like interested bureaucrats, nonetheless (even if grudgingly) allowed that these bodies in their respective, though possibly limited ways were working towards, if not a solution to, then at least an amelioration of the Aboriginal drink problem. People from the ACM and the ASG talked to members of the wider community about alcohol, befriended drinkers who either asked for or required relief and, crucially, had clients who privately or publicly recounted how they owed their lives and continued well-being to assistance received. That ACM and ASG energetically competed for the same clientele and eagerly used any information conveyed by disgruntled customers of their opponents in developing offensive critiques was frequently overlooked. Woma and its Secretariat had absolutely no clientele to turn to in order to have their praises sung (more accurately their intended clientele [ACM and ASG staff] were among their harshest detractors), making the continued criticism singularly devastating.

The State, through the instrumentality of the DAA, interpreted the intense infighting in the drink rehabilitation arena not as the product of its own enduring, interfering patronage but as evidence that Aborigines required continued external assistance. And as in the past, rather than recognising and addressing the way the prevailing Aboriginal-state relationship operated to maintain Aborigines and

Aboriginal organisations as dependent clients, staff sought to bring about change and 'progress' by here and there promoting 'new initiatives', none of which threatened the basic structure. This resulted in things being maintained much as they had been, with the state depicting itself as genuinely and generously seeking to assist Aborigines, and Aborigines seemingly unable or (perversely) unwilling to make the most of the aid being directed their way.

Conclusion

The history of government involvement in aspects of Aboriginal liquor use and abuse is a long one. It is also, contrary to recent rhetoric, remarkably consistent. The early protection policy sought to safeguard White interests by controlling the behaviour of Blacks. The current self-determination or self-management phase is an extension of this. Nungas can and do use it to construct certain claims and make limited demands. At the same time the state is able to continue intervening in Aboriginal activities. This is veiled by being made to look as though it is an accommodating response to Aboriginal requests; whereas actually Aboriginal claims reflect the unaltered nature of the relationship between Aborigines and the state.

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End Notes

1. The fact that in some areas e.g. Western Australia, incentives to assimilate were officially linked with the term 'citizenship', plus the fact that what was being held out to Blacks were rights equal to those taken for granted by Whites, combined to produce a situation wherein many Aborigines used the phrases 'drinking rights' and 'citizenship rights' interchangeably.

2. For many Whites the lives of people like the Northern Territory artist Albert Namatjira and actor Robert Tudawali, men alleged to have been 'caught between two cultures', epitomise the (unintended) impact of the new approach. Both fell foul of the law for supplying liquor to kin; both were arrested on drunkenness charges; and the use and abuse of liquor by both is said to have contributed heavily towards their early deaths.

3. The last restrictions were removed in 1968.

4. *See* Peterson (1985) for a thought provoking interpretation of the economic conditions which underwrote this increased expenditure on things Aboriginal and the consequences it had for Land Rights.

5. This process of government sponsorship being a precursor to a chain of official enquiries (which justify various types and degrees of intervention) parallels the history of what began as the National Aboriginal Consultative Committee (Weaver 1983).

6. Allusions to the inadequate training of workers were made by bureaucrats and program employees in accounting for or explaining the 'overall lack of success' of the rehabilitation endeavour.

7. It could be argued this is not evidence of a 'failing' in rehabilitation programs, but the consequence of the absence of change at the level of the supposed underlying causes of Aboriginal drinking.

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THE SOUTH AUSTRALIAN MUSEUM'S ABORIGINAL FAMILY HISTORY PROJECT

As part of the South Australian Museum's responsibility to record and preserve items of Aboriginal heritage, Museum staff have been collecting photographs of Aboriginal people from as early as the end of last century — some of the photographs date from the 1860s. In the 1930s, Norman Tindale, the Museum's anthropologist, began systematically photographing Aboriginal people at different locations around the country. This was part of a larger research project funded by Harvard University and the University of Adelaide's Board for Anthropological Research. By the end of the 1950s, Tindale had not only photographed Aboriginal people from all around Australia (Table 1) but had also gathered detailed genealogies of the people in these photographs (Table 2).

In the late 1970s, the Museum employed an archivist and an assistant to reorganise and store in a new archive the large collection of photographs, sound recordings, documents (including genealogies) and other materials. The Museum's archival collection is an invaluable resource relating to the Aboriginal history of South Australia and of the whole country. Over the last seven years, the Museum has given copies of its photographs to many individuals and communities, especially in the southern parts of the state. As a result, documentation relating to the photographs has often been obtained and old photographs have been given to the Museum by Aboriginal people for copying.

In the 1980s, Aboriginal people began to use the genealogies compiled by Tindale. Doreen Kartinyeri, a Ngarrindjeri historian, was the first Aboriginal person in South Australia to use this resource. By 1987, with an increase of Aboriginal interest in the Museum's resources, Tindale gave permission for photographs and genealogical information to be supplied to Aboriginal people from his unpublished material.

In 1987 the demand for access to the Museum's genealogical and photographic resources became too great for existing staff and Museum funds. To alleviate this situation, a formal project called the 'Aboriginal Family History Project' was established. The major aim of this project was to make the Museum's archival resources available to Aboriginal people.

Ms Doreen Kartinyeri was well known to the Museum at that time and her employment on the project was seen as essential. Her knowledge of southern South Australian Aboriginal families is very detailed and her familiarity with early photographs an invaluable skill when dealing with the Museum's large collection. Ms Kartinyeri had been working towards publishing genealogies of all the southern South Australian Aboriginal families and had already published the genealogies of the Rigney and Wanganeen families. Her skills and her research plans complemented the resources the Museum had to offer the Aboriginal community. It was therefore decided to employ her as an Aboriginal Research Officer with the Museum's Aboriginal Family History Project. The Museum would provide support for her research and use her skills to upgrade the Museum's resources and make them available to Aboriginal people.

In early 1988, the Australian Institute of Aboriginal Studies provided the initial financial support to the project, enabling the Museum to employ Ms Kartinyeri for three months. However, for the Museum to meet the demand from the Aboriginal community, and to provide proper support for her research and publication program, it was decided that a research assistant and a project officer were also required. The Museum was able to fill these positions at the beginning of the 1988/89 financial year with substantial funding from the Commonwealth Department of Aboriginal Affairs.

Mr Barry Craig, an anthropologist, is now the project officer and Ms Neva Grzybowicz, who has strong links with the Koonibba Aboriginal community, is the project's research assistant. Mr Craig assists with developing publications and reports relating to the project. He also coordinates its daily running. Ms Grzybowicz assists Ms Kartinyeri and is accumulating material to publish Tindale's material from the west coast of South Australia.

There are also a number of permanent Museum staff playing significant roles in the project. They are Mr Vince Buckskin, Ms Kaye Clark, Dr Chris Anderson, Mr Philip Clarke, and myself as Project Manager. Mr Buckskin, Ms Clark and Dr Anderson assist the grant-funded staff with enquiries and Mr Clarke has devised the extensive computer data-bases that make the resources more readily accessible. For example, all the named Tindale photographs have now been entered onto computer and a computer index of people mentioned in the genealogies has been started. Dr Deane Fergie, working on the Museum's Lake Eyre Basin Project, is focusing on the demographic history of the region and will therefore also be contributing a significant amount of material to the Museum's Aboriginal family history data-base.

TABLE 1. Expeditions organised by Norman B. Tindale on which photographs of Aboriginal people held by the South Australian Museum were taken. BAR/SAM = expeditions by Norman B. Tindale funded jointly by the Board for Anthropological Research, University of Adelaide, and the South Australian Museum, 1932–57. HAU = expeditions by Norman B. Tindale funded jointly by Harvard University and the University of Adelaide, 1938–39. UCAU = expeditions by Norman B. Tindale, J. B. Birdsell and P. J. Epling, funded jointly by the University of California at Los Angeles and the University of Adelaide, 1952–54.

Location	Source	Dates	Number of photos held
South Australia			
1. Bookabie	UCAU	Dec. 1952	18
2. Colona	UCAU	Dec. 1952	12
3. Erliwanjawanja	BAR/SAM	May–July 1933	10
4. Ernabella	BAR/SAM	May–July 1933	110
5. Koonibba	BAR/SAM	August 1928	57
Koonibba	HAU	1938–1939	88
Koonibba	UCAU	Dec. 1952	44
6. Mirramitta	BAR/SAM	August 1934	12
7. Nepabunna	BAR/SAM	May 1937	9
8. Nullarbor Station	HAU	June 1939	6
9. Ooldea	BAR/SAM	August 1939	95
10. Pandi Pandi	BAR/SAM	August 1934	61
11. Point McLeay	HAU	1938–1939	118
12. Point Pearce	HAU	1938–1939	83
13. Poka Gap	BAR/SAM	May–July 1933	23
Poka, Mann Range	BAR/SAM	May–July 1933	30
14. Port Augusta	HAU	June 1939	15
15. Swan Reach	HAU	1938	26
16. Umbukulu	BAR/SAM	May–July 1933	17
		Total	834
Western Australia			
17. Albany	HAU	April 1939	14
18. Anna Plains	UCAU	July 1953	13
19. Balgo	UCAU	August 1954	69
20. Borden	HAU	April 1939	25
21. Brooking Springs	UCAU	July 1954	4
22. Broome	UCAU	August 1953	41
23. Christmas Creek	UCAU	May 1954	83
24. Collie	HAU	March 1939	7
25. Cookes Creek	UCAU	April 1953	6
26. Cosmo Newberry	UCAU	Feb. 1953	62
27. Cundeelee	UCAU	Jan. 1953	24
28. Derby	UCAU	1953–1954	74
29. Fitzroy Crossing	UCAU	July 1954	29
30. Flora Valley	UCAU	Oct. 1953	36
31. Forrest River	UCAU	March 1954	153
32. Gnowangerup	HAU	March–April 1939	40
33. Gogo	UCAU	June 1954	60
34. Gordon Downs	UCAU	April 1954	75
35. Hall's Creek	UCAU	October 1953	21
36. Jigalong	UCAU	March 1953	76
37. La Grange	UCAU	July 1953	73
38. Laverton	HAU	May 1939	29
39. Leopold	UCAU	July 1954	19

Location	Source	Dates	Number of photos held
Western Australia			
40. Liveringa	UCAU	Sept. 1953	22
41. Mandora	UCAU	July 1953	34
42. Marble Bar	UCAU	April 1953	116
43. Margaret River	UCAU	May 1954	36
44. Meda	UCAU	August 1953	22
45. Meekatharra	UCAU	Jan. 1953	10
46. Moola Bulla	UCAU	1953-1954	295
47. Moore River	HAU	April 1939	75
48. Mount Barker	HAU	April 1939	33
49. Mount Margaret	HAU	May 1939	118
Mount Margaret	UCAU	Feb.-March 1953	91
50. Mulga Queen	UCAU	Feb. 1953	30
51. Narrogin	HAU	April 1939	15
52. Noonkanbah	UCAU	July 1954	22
53. Norseman	HAU	June 1939	27
54. Pilgangoora	UCAU	May-June 1953	369
55. Quanbun	UCAU	June 1954	15
56. Roebourne	UCAU	June-July 1953	73
57. Southern Cross	HAU	May 1939	31
58. Sturt Creek	UCAU	May 1954	94
59. Thangoo	UCAU	August 1953	14
60. Warupuju	BAR/SAM	August 1935	43
61. Wiluna	UCAU	January 1953	34
62. Wotjulum	UCAU	June-July 1954	118
63. Yeeda	UCAU	August 1953	5
		Total	2775
Northern Territory			
64. Cockatoo Creek	BAR/SAM	August 1931	85
65. Darwin	UCAU	Feb.-March 1954	8
66. Granites	BAR/SAM	August 1936	38
67. Hermannsburg	BAR/SAM	August 1929	91
68. Inverway	UCAU	April 1954	59
69. MacDonald Downs	BAR/SAM	August 1930	57
70. Mount Liebig	BAR/SAM	Aug.-Sept. 1930	93
		Total	431
Queensland			
71. Cherbourg	HAU	Nov.-Dec. 1938	152
72. Mona Mona	HAU	Aug.-Sept. 1938	148
73. Palm Island	HAU	Oct.-Nov. 1938	246
74. Woorabinda	HAU	Nov. 1938	140
75. Yarrabah	HAU	Sept.-Oct. 1938	267
		Total	953

Location	Source	Dates	Number of photos held
New South Wales			
76. Boggabilla	HAU	July 1938	65
77. Brewarrina	HAU	June-July 1938	118
78. Cummerangunja	HAU	1938-1939	54
79. Kempsey	HAU	Dec. 1938	3
80. Menindee	HAU	June 1939	9
81. Pilliga	HAU	1938-1939	39
82. Walgett	HAU	1938-1939	2
83. Wallaga Lakes	HAU	1938-1939	23
84. Woodenbong	HAU	August 1939	62
		Total	375
Victoria			
85. Lake Tyers	HAU	1938-1939	52
Tasmania			
86. Cape Barren Island	HAU	1939	129
		Total number of photographs, all states	5549

The specific objectives of the project are as follows:

a) to provide a computer index of names appearing in the Tindale genealogies for each locality throughout Australia.

b) to establish a complete set of negatives and copy prints of the Tindale photographs. This is as yet incomplete for some states.

c) to support Ms Kartinyeri's publication program, involving the publication of the genealogies of almost 40 Aboriginal families from southern South Australia. She has published three so far — the Rigney, Wanganeen and Kartinyeri families — and another five are almost ready for publication. Considerable work has already been done on the others.

d) to publish Tindale's South Australian material in a form easily accessible to the Aboriginal community. Once material is published, then the number of enquiries should be greatly reduced.

e) to encourage organisations in other states to take on the project for their regions and to work towards publishing the material in an accessible form.

Access to family history information has to be provided cautiously. Information which may offend people must be identified and dealt with according to the wishes of those concerned. Aboriginal researchers with detailed knowledge of their communities are therefore essential in a project like this. A publishing program is the best way to make the edited information available and is essential to deal with the potentially open-ended nature of this project. However, publication first requires extensive consultation and Aboriginal research involvement. South Australia is fortunate to have an experienced Aboriginal family history researcher such as Ms Kartinyeri and it is hoped that a permanent position can be secured for her in the South Australian Museum.

S. J. HEMMING, Project Manager, Aboriginal Family History Project, South Australian Museum, North Terrace, Adelaide, South Australia 5000. *Rec. S. Aust. Mus.* 23(2), 147-152, 1989.

TABLE 2. Listing of genealogies of Aboriginal people held by the South Australian Museum, and obtained on expeditions organised by N. B. Tindale. Expedition abbreviations as for Table 1.

Location	Source	Year	Volume	Page Nos	Total
South Australia					
1. Koonibba	HAU	1939	6	105–163	57
2. Nullarbor	HAU	1939	7	211–213	3
3. Point McLeay	HAU	1939	6	1–66	70
4. Point Pearce	HAU	1939	6	69–104	35
5. Poonindee	BAR/SAM	1940		1–2	2
6. Port Augusta	HAU	1939	6	164–172	10
7. Swan Reach	HAU	1939	6	104a–104j	10
				Total	187
Western Australia					
8. Albany	HAU	1939	7	26–31	6
9. Anna Plains	UCAU	1953	2	203–210	8
10. Balgo	UCAU	1954	5	863–886	24
11. Borden	HAU	1953	7	19–25	7
12. Brooking Springs	UCAU	1954	5	859–862	4
13. Broome	UCAU	1953	3	254–277	24
14. Christmas Creek	UCAU	1954	4	659–697	39
15. Collie	HAU	1939	7	1–5	5
16. Cookes Creek	UCAU	1953	2	35–37	3
17. Derby	UCAU	1953	3	278–303	26
Derby	UCAU	1954	5	798–817	20
18. Fitzroy Crossing	UCAU	1954	5	828–831	4
Fitzroy Mission	UCAU	1954	5	846–855	10
Fitzroy Police Stn	UCAU	1954	5	856–858	3
19. Flora Valley	UCAU	1953	3	483–502	20
20. Forrest River	UCAU	1954	4	503–537	35
21. Gnowangerup	HAU	1939	7	6–18	13
22. Gogo	UCAU	1954	4	698–729	32
23. Gordon Downs	UCAU	1954	4	556–598	43
24. Hall's Creek	UCAU	1953	3	474–482	9
25. Jigalong	UCAU	1953	1	25–32, 62–73	20
26. La Grange	UCAU	1953	2	211–228	18
La Grange	UCAU	1953	3	229–245	17
27. Laverton	HAU	1939	7	189–196	7
28. Leopold Downs	UCAU	1954	5	832–845	14
29. Liveringa	UCAU	1953	3	324–334	11
30. Mandora	UCAU	1953	2	191–202	12
31. Marble Bar	UCAU	1953	2	1–34, 38–41	55
32. Margaret River	UCAU	1954	4	646–658	13
33. Meda	UCAU	1953	3	304–318	15
34. Moola Bulla	UCAU	1953	3	335–473	139
35. Moore River	HAU	1939	7	46–107	61
36. Mount Barker	HAU	1939	7	32–41	10
37. Mount Florance	UCAU	1953	2	182–185	4
38. Mount Margaret	HAU	1939	7	124–188, 197	65
Mount Margaret	UCAU	1953	1	33–61	28
39. Narrogin	HAU	1939	7	42–45	5
40. Noonkanbah	UCAU	1954	5	818–827	10
41. Norseman	HAU	1939	7	198–210	12
42. Pilgangoora	UCAU	1953	2	42–143	101
43. Port Headland Hosp.	—	1949–53	2	1–2	2
Port Headland	UCAU	1953	2	144–151	7
44. Quanbun	UCAU	1954	4	730–739	10

Locations	Source	Year	Volume	Page-Nos	Total
Western Australia					
45. Roebourne	UCAU	1953	2	167–181	15
Roebourne	UCAU	1953	2	186–190	5
46. Southern Cross	HAU	1939	7	108–123	16
47. Sturt Creek	UCAU	1954	4	599–645	47
48. Thangoo	UCAU	1953	3	246–253	8
49. Warupuju	BAR/SAM	1935	—	1–24	24
50. Wiluna	UCAU	1953	1	1–24	24
51. Wotjulum	UCAU	1954	4	740–797	58
52. Yandeyarra	UCAU	1953	2	152–166	16
53. Yeeda	UCAU	1953	3	319–322	4
				Total	1188
Northern Territory					
54. Haast Bluff	BAR/SAM	1956–57	—	1–117, 1, 1–9	128
55. Inverway	UCAU	1954	4	538–555	18
56. Mount Liebig	BAR/SAM	1932	—	1–8	8
57. Yuendumu	BAR/SAM	1951	—	1–90	91
				Total	245
Queensland					
58. Cherbourg	HAU	1918–38	4	i–xv	15
Cherbourg	HAU	1938	4	1–110	110
59. Mona Mona	HAU	1938	2	1–47	47
60. Palm Island	HAU	1938	3	1–245	245
61. Woorabinda	HAU	1938	4	1–114	114
62. Yarrabah	HAU	1938	2	1–98	98
				Total	629
New South Wales					
63. Boggabilla	HAU	1938	1	1–18	21
64. Brewarrina	HAU	1938	1	1a–40	43
65. Cummeragunja	HAU	1938	1	1a–13	36
66. Kempsey	HAU	1938	5	1–2	2
67. Maloga Mission, Echuca	HAU	1879	1	43–44	2
68. Menindee	HAU	1939	6	173–179	8
69. Pilliga	HAU	1938	1	1–12	12
70. Wallaga Lake	HAU	1939	5	1–9	9
71. Woodenbong	HAU	1938	2	1–20	20
				Total	153
Victoria					
72. Lake Tyers	HAU	1939	5	1–26	26
Tasmania					
73. Cape Barren Island	HAU	1939	5	1–36	37
74. Emita, Flinders Is.	HAU	1949	5	27, 29	2
				Total	39
				Total, all states	2467

RECORDS OF THE SOUTH AUSTRALIAN MUSEUM

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AMPHIBIAN TYPE SPECIMENS IN THE SOUTH AUSTRALIAN MUSEUM

MICHAEL J. TYLER

TYLER, M.J. 1990. Amphibian type specimens in the South Australian Museum. *Rec. S. Aust. Mus.* 24(1): 1-9.

Type specimens of 95 species and sub-species of frogs (Amphibia: Anura) are housed in the South Australian Museum. The collection includes holotypes and syntypes of 36 species. The majority of species (55) is from Australia, and all but one of the remainder are from New Guinea and New Britain. The total includes three fossil species.

The significance of the type collection is demonstrated by the fact that it includes slightly more than 25% of the extant frog fauna of Australia.

M.J. Tyler, South Australian Museum, North Terrace, Adelaide, South Australia 5000. Manuscript received 8 May 1989.

The first type specimen of a frog to be lodged in the South Australian Museum was *Crinia affinis halmaturina* Condon (1941) from Kangaroo Island. Unfortunately the specimen involved cannot be located, and could not be found in 1960 when the entire frog collection occupied only four small shelves in a corner of the old spirit room. At that time I asked Condon whether he could cast any light on the whereabouts of the missing specimen, but he was unable to do so.

Somewhat fortuitously, the loss of the type of *C. affinis halmaturina* is of historic rather than scientific significance. The Kangaroo Island population cannot be distinguished from mainland *C. signifera* Girard (1853), and at present there are no grounds upon which subspecific status for it can be sustained.

It was not until 1963 that further type specimens were added to the collection: *Hyla micromembrana* Tyler and *H. mintima* Tyler. But in less than a further 15 years the collection had expanded to such an extent that a list of type specimens was produced (Tyler, 1976). In that list was included representatives of 34 species and subspecies, and holotypes or syntypes of 21 species.

The need for an updated type list is demonstrated by the fact that the type collection has increased by more than 150% since 1976. It now includes 95 species and subspecies, including holotypes or syntypes of 36 species. Furthermore the significance of the collection is demonstrated by the presence of the types of 55 Australian species, so representing slightly more than 25% of the known frog fauna of Australia.

AMPHIBIA: ANURA

Family **Hylidae**

Australobatrachus ilius Tyler, 1976
Trans. R. Soc. S. Aust. **100**: 13.
Holotype: SAM P18021, two fragments distal portion of left ilium, Lake Palankarinna, Etadunna Formation, S.A., Tertiary.

Cyclorana cryptotis Tyler & Martin, 1976
Rec. S. Aust. Mus. **17**: 271.
Holotype: SAM R14716, Daly Waters, N.T., B. Low and D.F. Gartside, 13 Dec. 1971.

Cyclorana maculosus Tyler & Martin, 1976
Rec. S. Aust. Mus. **17**: 269.
Holotype: SAM R14719, Daly Waters, N.T., B. Low and D.F. Gartside, 13 Dec. 1971.
Paratypes: SAM R14717-18 (collected with holotype); SAM R7612, Doomadgee Mission, Qld, G. Douglas, Feb. 1966; SAM R14736, Tennant Creek, N.T., J.F. Field, April 1907.

Cyclorana maini Tyler & Martin, 1976
Rec. S. Aust. Mus. **17**: 273.
Holotype: SAM R15191, Barrow Creek, N.T., D.F. Gartside and B. Low, 11 Dec. 1971.
Paratypes: SAM R15192, 10 km S Alice Springs, N.T., 11 Nov. 1963; SAM R6311, 14715, 27 km S Alice Springs, N.T., M.R. Warburg, 1964; SAM R13038 A-D, Toko Range, N.T., S.A. Parker, 20 Jan. 1972; SAM R1711, Well No. 26, Canning Stock Route Expedition, W.A., April 1930-Aug. 1931; SAM R5979, 15341-46, Mt Edgar, W.A., A.R. Main and G.M. Storr, Feb. 1961.

Cyclorana manya Van Beurden & McDonald, 1980
Trans. R. Soc. S. Aust. **104**: 193.
Paratypes: SAM R17420-24, Airstrip, Coen, Qld, R.G. Atherton and K.R. McDonald, 6-8 March 1979.

Cyclorana vagitus Tyler, Davies & Martin, 1981
Rec. W. Aust. Mus. **9**: 148.
Paratypes: SAM R18008-10, junction Gt Northern

Hwy and road to Derby, 41 km S Derby, W.A., A.H. Cross, M. Davies, A.A. Martin and M.J. Tyler, 14–21 Feb. 1981; SAM R16535, Parry Creek Road, Kununurra, W.A., M. Davies, A.A. Martin and M.J. Tyler, 24 Feb. 1977.

Cyclorana verrucosus Tyler & Martin, 1976
Rec. S. Aust. Mus. **17**: 267.
Paratype: SAM R14081, Sturt Ntl Pk, nr Tibooburra, N.S.W., R. Galt, May 1974.

Hyla albolabris Wandolleck, 1911
Abh. K. zool. Anthrop.-ethn. Mus. Dresden **13**(6): 12.
= *Litoria albolabris* (Wandolleck), *vide* Tyler (1971: 352).
Syntype: SAM R4947, Aitape, New Guinea, O. Schlaginhaufen, 1910.

Hyla bulmeri Tyler, 1968
Zool. Verh. (96): 56.
= *Litoria bulmeri* (Tyler), *vide* Tyler (1971: 352).
Holotype: SAM R5625, Glkm, Upper Aunjung Valley, Schrader Mts, New Guinea, R.N.H. Bulmer, 2 Jan. 1964.
Paratypes: SAM R5624, R8107 (same locality), R.N.H. Bulmer, 17 Nov. 1963.

Hyla contrastens Tyler, 1968
Zool. Verh. (96): 72.
= *Litoria contrastens* (Tyler), *vide* Tyler (1971: 352).
Holotype: SAM R5845, Barabuna, nr Kundiawa, New Guinea, F. Parker, 16 Aug. 1964.
Paratype: SAM R6450 (same data as holotype).

Hyla coplandi Tyler, 1968
Rec. S. Aust. Mus. **15**(4): 716.
= *Litoria coplandi* (Tyler), *vide* Tyler (1971: 352).
Paratype: SAM R9103, Wave Hill, N.T., K.G. Buller, 8 Aug. 1960.

Hyla dorsivena Tyler, 1968
Zool. Verh. (96): 83.
= *Litoria dorsivena* (Tyler), *vide* Tyler (1971: 352).
Holotype: SAM R7901, Telefomin, New Guinea, B. Craig, Nov. 1963.
Paratypes: SAM R7902–10 (same data as holotype). (R7911 transferred to Museum of Natural History, University of Kansas. Now KU 153143.)

Hyla leucova Tyler, 1968
Zool. Verh. (96): 119.
= *Litoria leucova* (Tyler), *vide* Tyler (1971: 353).
Holotype: SAM R6461, Busilmin, New Guinea, B. Craig, 1 May 1965.

Hyla meiriana Tyler, 1969
Rec. S. Aust. Mus. **16**(1): 2.
= *Litoria meiriana* (Tyler), *vide* Tyler (1971: 353).
Holotype: SAM R9082, 157 km N Mainoru, N.T., A. Fleming, R. Edwards and H. Bowshall, 19 Aug. 1967.
Paratypes: SAM R9014–32, 9034, 9074–81, 9083–85 (same data as holotype). (R9033 transferred to Museum of Natural History, University of Kansas. Now KU 153144.)

Hyla micromembrana Tyler, 1963
Trans. R. Soc. S. Aust. **86**: 121.
= *Litoria micromembrana* (Tyler), *vide* Tyler (1971: 353).
Holotype: SAM R4150, Mt Podamp, nr Nondugl, New Guinea, M.J. Tyler, 1 April 1960.

Hyla mintima Tyler, 1963
Trans. R. Soc. S. Aust. **86**: 123.
= *Litoria angiana* (Boulenger), *vide* Tyler (1971: 354).
Holotype: SAM R4151, Mintima, nr Kerowaghi, New Guinea, M.J. Tyler, 1 June 1960.

Hyla modica Tyler 1968
Zool. Verh. (96): 135.
= *Litoria modica* (Tyler), *vide* Tyler (1971: 354).
Paratype: SAM R8108, Oruge, Eastern Highlands, New Guinea, F. Parker, 18 April 1965.

Hyla multiplica Tyler, 1964
Amer. Mus. Novit. (2187): 2.
= *Litoria multiplica* (Tyler), *vide* Tyler (1971: 354).
Paratype: SMA R4946, Kassam, 4500 m, Kratke Mts, New Guinea, H.M. Van Deusen, 8 Nov. 1959.

Hyla prora Menzies, 1969
Trans. R. Soc. S. Aust. **93**: 165.
= *Litoria prora* (Menzies), *vide* Tyler (1971: 354).
Paratypes: SAM R10410–11, nr Efogi, Owen Stanley Mts, New Guinea (9°9′S, 147°38′E), J.I. Menzies, 12 Dec. 1968.

Hyla spinifera Tyler, 1968
Zool. Verh. (96): 167.
= *Litoria spinifera* (Tyler), *vide* Tyler (1971: 354).
Paratypes: SAM R6928–31, Oruge, New Guinea, F. Parker, 18 April 1965.

Hyla wisselensis Tyler, 1968
Zool. Verh. (96): 180.
= *Litoria wisselensis* (Tyler), *vide* Tyler (1971: 355).
Paratypes: SAM R5539–43, Enarotali, L. Paniai, Wissel Lakes, Irian Jaya, M. Boeseman and L.D. Holthius, 8 Jan. 1955.

Litoria brevipalmata Tyler, Martin & Watson, 1972
Proc. Linn. Soc. N.S.W. **97**(1): 82.
Holotype: SAM R11236, Ourimbah Creek, 8 km NW Gosford, N.S.W., F. Parker, 29 Jan. 1971.

Litoria exophthalmia Tyler, Davies & Aplin, 1986
Trans. R. Soc. S. Aust. **110**: 63.
Paratypes: SAM R27831–32, Haia Village (6°42′S, 145°00′E), South Simbu Province, Paupa New Guinea, K. Aplin, 14 June 1984.

Litoria glandulosa Tyler & Anstis, 1975
Rec. S. Aust. Mus. **17**(5): 46.
= *Litoria subglandulosa* Tyler & Anstis, *vide* Tyler & Anstis (1983).
Holotype: SAM R13504, Barwick Creek, Point Lookout, nr Ebor, N.S.W., M. Anstis, 24 Jan. 1973.
Paratypes: SAM R13505–10, Barwick and Bullock Creeks, Ebor, M. Anstis, 24 Jan. 1973; R13060 (11 juveniles), Barwick Creek, M. Anstis, Jan. 1973; R13303, Barwick Creek, M. Anstis, 10 Jan. 1971; R13626–39, Point Lookout, M. Anstis, May 1973.

Litoria longirostris Tyler & Davies, 1977
Copeia **1977**: 620.
Paratypes: SAM R15190, 15221–22, Rocky River, McIllwraith Range, Cape York Peninsula, Qld (13°46′S, 142°23′E), P.S. Laverack, B. Gray and R.J. Grimes, 26 Sept. 1975 (topotypes).

Litoria lorica Davies & McDonald, 1979
Trans. R. Soc. S. Aust. **103**: 170.
Paratypes: SAM R17348–51, Alexandra Creek, nr Thornton Peak, Qld (16°7′S, 145°20′E), J.W. Winter and R.G. Atherton, 10 Dec. 1976 (topotypes).

Litoria pallida Davies, Watson & Martin, 1983
Trans. R. Soc. S. Aust. **107**: 101.
Holotype: SAM R19555, Gulungul Creek Crossing, Arnhem Hwy, N.T., G.A. Crook, 10 Dec. 1978.
Paratypes: SAM R19539, 4 km W Baralil Creek, G.A. Crook, M. Davies and M.J. Tyler, 30 Nov. 1978; SAM R19549, 40 km N Elliot, N.T., M. Davies, A.A. Martin & M.J. Tyler, 16 Dec. 1980; SAM R19451–57, Jabiru Airstrip, N.T., G.A. Crook, 4 Nov. 1978–7 Dec. 1979; SAM R19458, 19491–504, 50 m N Retention Pond No. 2, Djalkmarra Creek, Jabiru, N.T., G.A. Crook, 5 Dec. 1979; SAM R19459–62, Coonjimba Billabong, N.T., G.A. Crook, 5 Dec. 1979; SAM R19463, 19474–90, Cannon Hill, N.T., M. King, 1 Aug. 1976; SAM R19464, soak from ore body, Jabiru, N.T., M. Davies and M.J. Tyler, 29 Nov. 1978; SAM R19465, 4 km W Baralil Creek, N.T., M. Davies and M.J. Tyler, 30 Nov. 1978; SAM R19466–69, McArthur R. Bridge on road to McArthur R. Stn, G.A. Crook, 24 Nov. 1979; SAM R19470–71, Gulungul Swamp, 150 m SE Gulungul Creek Crossing, Arnhem Hwy, G.A. Crook, 1 Feb. 1979; SAM R19472–73, 800 m W Gulungul Creek Crossing, Arnhem Hwy, G.A. Crook, 1 Feb. 1979; SAM R19506, Coonjimba Billabong, N.T., G.A. Crook, 23 Oct. 1978; SAM R19507, Jabiru Airstrip, N.T., M. Davies and M.J. Tyler, 29 Nov. 1978; SAM R19511–13, Collyer Lagoon, Carpentaria Hwy, N.T., G.A. Crook and W. Zeidler, 26 Sept. 1977; SAM R19514–33, L. Woods, N.T., G.A. Crook and W. Zeidler, 5 Oct. 1977; SAM R19540–48, Bullman Hstd, N.T., R. Edwards, 8 Aug. 1966; SAM R9602–03, 133 km N Mainoru, R. Edwards and A. Fleming, 23 Aug. 1967; SAM R14775, 19508–09, 16 km S Hooker, N.T., A. Robinson, 5 June 1975; SAM R19550–51, Jabiru Airstrip, N.T., M. Cappo, M. Davies and M.J. Tyler, 10 Jan. 1981; SAM R19552, 100 m E Jim Jim turnoff, Arnhem Hwy, M. Cappo, M. Davies, M.J. Tyler and G.F. Watson, 9 Jan. 1981; SAM R19553–54, 800 m W Gulungul Crossing, Arnhem Hwy, N.T., G.A. Crook, 1 Feb. 1979; SAM R14774, 19510, 19 km N Laura, Qld, A.R. Robinson, 23 Oct. 1974; SAM R19535, Camballin, W.A., M. Davies, A.A. Martin and M.J. Tyler, 18 Feb. 1980; SAM R19536–38, 175 km E Broome, W.A., M. Davies, A.A. Martin and M.J. Tyler, 17 Feb. 1980.

Litoria personata Tyler, Davies & Martin, 1978
Trans. R. Soc. S. Aust. **106**: 151.
Holotype: SAM R16773, Birndu, SE Cannon Hill Stn, East Alligator River Regn, N.T. (12°32′S, 132°8′E), M. Davies, G. Miles and M.J. Tyler, 27 Nov. 1977; SAM R16774–75, Cannon Hill Stn, N.T., G. Miles, Aug. 1977; SAM R16776, Bradshaw Creek, Cannon Hill, N.T., G. Miles, 2 Feb. 1977; SAM R16829, 16855–56, Cannon Hill, G. Miles and M.J. Tyler, 26 April 1978; SAM R16830–32 (topotypes), G. Miles and I. Morris, 20 May 1978.

Litoria piperata Tyler & Davies, 1985
Copeia **1985**: 145.
Paratypes: SAM R13887–90, Back Creek, Oakwood Fire Trail, approx. 38 km SE Glen Innes, N.S.W. (29°50′S, 152°08′E), G. Webb and E. Mills, 27 March 1973 (topotypes); SAM R13884–86, Diehard Creek, 45 km E Glen Innes on Old Grafton Road, N.S.W., G. Webb, E. Mills and J. Barker.

Litoria quadrilineata Tyler & Parker, 1974
Trans. R. Soc. S. Aust. **98**(2): 71.
Holotype: SAM R13489, Jalan Trikora (= Trikora Road), Merauke, Irian Jaya, F. Parker, 4 March 1973.
Paratypes: SAM R13490–93, collected with holotype by F. Parker.

Litoria timida Tyler & Parker, 1972
Trans. R. Soc. S. Aust. **96**(3): 157.
Holotype: SAM R11658, Menemsorae, Western

District, New Guinea, F. Parker, 30 March 1969.
Paratypes: SAM R11659–61 (same data as holotype).

Litoria tyleri Martin, Watson, Gartside, Littlejohn & Loftus-Hills, 1978
Proc. Linn. Soc. N.S.W. **103**(1): 25.
Paratypes: SAM R12248, Lisarow, N.S.W., F. Parker and H. Ehmann, 25 Jan. 1971; SAM R12251–52, 1 ml S, 6 ml W, Wyong, N.S.W., F. Parker, H. Ehmann and P. Krauss, 26 Jan. 1971; SAM R12250, Ourimbah, N.S.W., F. Parker and H. Ehmann, 25 Jan. 1971; SAM R12253, 12255, Ourimbah, N.S.W., F. Parker, H. Ehmann and P. Krauss, 29 Jan. 1971.

Litoria umbonata Tyler & Davies, 1983
Copeia **1983**: 803.
Paratypes: SAM R21529–32, Baliem Valley, 1600 m, Irian Jaya, P. Mathiessen, 8–10 June 1961.

Litoria xanthomera Davies, McDonald & Adams, 1986
Proc. R. Soc. Vict. **98**: 66.
Paratypes: SAM R24529–39, Henrietta Creek, Palmerston Ntl Pk, Qld (17°37′S, 145°40′E), K.R. McDonald, 13 Feb. 1980 (topotypes); SAM R16794–98, 24524–25, Gadgarra S.F., Qld (17°16′30″S, 145°40′E), K.R. McDonald and R.G. Atherton, 14 Feb. 1977; SAM R2426, Milaa Milaa Falls, 2 km from Milaa Milaa, Qld (17°30′S, 145°37′E), K.R. McDonald and R.G. Zweifel, 16 Jan. 1981; SAM R24528, Kuranda S.F., 2.6 km along Black Mt Road from Kuranda, Qld (16°48′S, 145°3′30″E), 24 Oct. 1981, K.R. McDonald, R.G. Zweifel and W. Hosmer; SAM R24529, nr Peeramon, Qld (17°19′S, 145°27′30″E), K.R. McDonald and R.G. Zweifel, 18 Jan. 1981; SAM R25736–40, Lannercost S.F., nr Wallamin Falls, Qld, K.R. McDonald and P. Minton, 16 Feb. 1984.

Nyctimystes montana Parker, 1936
Ann. Mag. nat. Hist. **17**: 80.
= *Nyctimystes cheesmani (nomen novum)* Tyler (1965: 268).
Paratype: SAM R9424, Mondo, New Guinea, L.E. Cheesman. Formerly British Museum (Natural History) 1947.2.10.93.

Nyctimystes trachydermis Zweifel, 1983
Amer. Mus. Novit. (2759): 12.
Paratype: SAM R24079, *ca* 4000′, Gapaia Creek, between Garaina and Saureli, Morobe Province, Papua New Guinea, R.G. Zweifel, 1 Sept. 1969.

Nyctimystes zweifeli Tyler, 1967
Trans. R. Soc. S. Aust. **91**: 191.
Holotype: SAM R5426, Telefomin, Western Highlands, New Guinea, B. Craig, 24 Nov. 1963.
Paratypes: SAM R8812–13, 8815–19 (same data as holotype). (R8814 transferred to Museum of Natural History, University of Kansas. Now KU 15345.)

Family **Leptodactylidae**

Arenophryne rotunda Tyler, 1976
Rec. W. Aust. Mus. **4**: 45.
Paratype: SAM R14521, 100 m from False Entrance Well Tank, Carrarang Stn, Shark Bay, W.A. (26°23′S, 113°,18′E), A. Baynes and T.A. Smith, 24 Aug. 1970.

Crinia affinis halmaturina Condon, 1941
Rec. S. Aust. Mus. **7**: 114.
= *Crinia signifera* Girard, *vide* Moore (1961: 234).
Holotype: SAM R2165, Flinders Chase, Kangaroo Id, S.A., Tate Society, Jan. 1940. (Specimen missing. Note: this specimen could not be found when a specific search for it was undertaken by M.J. Tyler in 1960.)

Crinia riparia Littlejohn & Martin, 1965
Copeia **1965**(3): 319.
Paratypes: SAM R9101–02, Alligator Gorge, Flinders Ranges, S.A., M.J. Littlejohn, A.A. Martin and P. Rawlinson.

Glauertia russelli Loveridge, 1933
Occ. Pap. Boston Soc. Nat. Hist. **8**: 89.
= *Uperoleia russelli* (Loveridge), *vide* Tyler *et al.* (1981).
Paratype: SAM R9723, Creek flowing into Gascoyne R., nr Landor Stn, W.A., L. Glauert.

Kyarranus kundagungan Ingram & Corben, 1975
Mem. Qld Mus. **17**(2): 335.
Paratypes: SAM R13921–22, Mistake Mts, *ca* 800 m, 83 km SW Brisbane, Qld (27°53′S, 152°21′E), C.J. Corben and A.K. Smyth, 3 Jan. 1974.

Lechriodus intergerivus Tyler, 1989
Trans. R. Soc. S. Aust. **113**: 16.
Paratypes (ilia): SAM P29742, Henk's Hollow Site; SAM P29764–65, Last Minute Site; SAM P29768, Gag Site; SAM P29734, 29743–44, 29757–62, Upper Site; SAM P29746–50, C.S. Site; SAM P29756, 29766–67, Wayne's Wok Site; SAM P29729, 29751–55, Outasite Site; SAM P29735–41, 29745, 29771, R.S.O. Site. (All sites at Riversleigh Stn, Queensland, Tertiary.)

Limnodynastes archeri Tyler, 1982
Alcheringa **6**: 101.
Holotype: SAM P23054, distal portion of left ilium,

Tedford Locality on west side of Lake Palankarinna, Etadunna Formation, S.A., Tertiary.
Paratype: SAM P23055, distal portion of left ilium. Data as above.

Limnodynastes dumerili variegatus Martin, 1972
Aust. J. Zool. **20**: 181.
Paratypes: SAM R13174–75, 6 km N Cape Otway, Vic., A.A. Martin, 8 Dec. 1976.

Megistolotis lignarius Tyler, Martin & Davies, 1979
Aust. J. Zool. **27**: 137.
Paratypes: SAM R16228–29, L. Argyle-Kununurra Road, 6.5 km N Lake Argyle Tourist Village, L. Argyle, W.A., A.A. Martin and M.J. Tyler, 19 Feb. 1977 (topotypes); SAM R16316 (type locality), M. Davies, A.A. Martin and M.J. Tyler, 21 Feb. 1977; SAM R16317–21 (Fl progeny of topotypes); SAM R16608, Gt Northern Hwy, 4.1 km N Maggie Creek, W.A., M. Davies, A.A. Martin and M.J. Tyler, 3 Feb. 1978; SAM R16609, Gt Northern Hwy, 5.2 km S Beta Creek, W.A., M. Davies, A.A. Martin and M.J. Tyler, 3 Feb. 1978; SAM R16322, 16377, Cannon Hill, N.T., G. Miles, 1977; SAM R16324–25, Birndu nr Cannon Hill, N.T., M. Davies, G. Miles and M.J. Tyler; SAM R16323, Mt Brockman Range, N.T., R. Pengilley, 1973.

Mixophyes fleayi Corben & Ingram, 1987
Mem. Qld Mus. **25**: 233.
Paratype: SAM R31036. No data.

Neobatrachus aquilonius Tyler, Davies & Martin, 1981
Rec. W. Aust. Mus. **9**: 155.
Paratypes: SAM R18012–14, 18032–33, 18101–02, 10–41 km S Derby, W.A., M. Davies, A.A. Martin and M.J. Tyler, 13–19 Feb. 1980.

Ranidella bilingua Martin, Tyler & Davies, 1980
= *Crinia bilingua, vide* Heyer *et al.* (1982).
Copeia **1980**: 94.
Paratypes: SAM R16837–39, Dead Horse Spring, 1.5 km NE Lake Argyle Tourist Village, L. Argyle, W.A., M. Davies, A.A. Martin and M.J. Tyler, 19 Feb. 1977; SAM R16840–41, Spillway Bridge, 11.5 km N Lake Argyle Tourist Village, W.A., M. Davies, A.A. Martin and M.J. Tyler, 20 Feb. 1977; SAM R16842, 20 km NE Lake Argyle Tourist Village, L. Argyle, M. Davies, A.A. Martin and M.J. Tyler, 20 Feb. 1977; SAM R16833, Ivanhoe Crossing, 11.5 km N Kununurra, W.A., M. Davies, A.A. Martin and M.J. Tyler, 25 Jan. 1978; SAM R16834–36, Mitchell Plateau, W.A., M. Davies, W.E. Duellman, A.A. Martin and M.J. Tyler, 26 Jan.–1 Feb. 1978.

Ranidella remota Tyler & Parker, 1974
Trans. R. Soc. S. Aust. **98**(2): 74.
= *Crinia remota* (Tyler & Parker), *vide* Heyer *et al.* (1982).
Holotype: SAM R13524, Morehead, Papua New Guinea, F. Parker, 18 June 1973.
Paratypes: SAM R13527–28, Gubam, 16 April 1972; R13525–26, R13681–82, Morehead, F. Parker, 19 May 1969.

Rheobatrachus vitellinus Mahony, Tyler & Davies, 1984
Trans. R. Soc. S. Aust. **108**: 155.
Paratypes: SAM R25446–47, Eungella Ntl Pk, Qld, K.R. McDonald and G. Chester, 10–12 Jan. 1984.

Uperoleia arenicola Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 26.
Holotype: SAM R16991, Birndu, East Alligator River Regn, N.T. (12°28′S, 132°56′E), G.A. Crook, M. Davies, A.A. Martin and M.J. Tyler, 30 Nov. 1978.
Paratypes: SAM R16992–96, 17347, taken with the holotype.

Uperoleia aspera Tyler, Davies & Martin, 1981
Rec. W. Aust. Mus. **9**: 159.
Paratypes: SAM R18093–97, 28 km S Derby, W.A. (17°30′S, 123°43′E), M. Davies, A.A. Martin and M.J. Tyler, 14 Feb. 1980 (topotypes); SAM R18098, Gt Northern Hwy, 8 km NE Broome, M. Davies, A.A. Martin and M.J. Tyler, 15 Feb. 1980.

Uperoleia borealis Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 30.
Paratypes: SAM R17077–78, 17083–84, Dead Horse Spring, 3.7 km NE of Lake Argyle Tourist Village, L. Argyle, W.A., M. Davies, A.A. Martin and M.J. Tyler, 19 Feb. 1977, SAM R17082, Stonewall Creek, 20 km NE L. Argyle, W.A., M. Davies, A.A. Martin and M.J. Tyler, 21 Feb. 1977.

Uperoleia capitulata Davies, McDonald & Corben, 1986
Proc. R. Soc. Vict. **98**: 163.
Paratypes: SAM R29586–87, 64 km SW Bulloo Downs Hstd, Qld, D.G. McGreevy and S. Tickler, 2 Oct. 1976; SAM R29588, Noccundra Hotel, Qld, K.R. McDonald and D.G. McGreevy, 30 Nov. 1975; SAM R29590, Boorara Stn, 32 km N Hungerford, Qld, S. May, late 1976; SAM R29589, Boorara Stn, D.G. McGreevy, 12 Jan. 1977; SAM R29591, King Tank, Ambathala Nature Reference Site, Qld (26°00′S, 145°00′E), K.R. McDonald and D.G. McGreevy, 3 May 1979; SAM R29592–95, D.P. Swamp, Charleville, Qld, P.D. McRae, 10 Feb. 1976.

Uperoleia crassa Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 34.
Paratypes: SAM R16904–18, 17079–80, Amax Campsite, Mitchell Plateau, W.A., M. Davies, W.E. Duellman, A.A. Martin and M.J. Tyler, 26–31 Jan. 1978.

Uperoleia fusca Davies, McDonald & Corben, 1986
Proc. R. Soc. Vict. **98**: 167.
Holotype: SAM R29596, S boundary Eungella Ntl Pk, 1.2 km along Crediton Rd from Broken R. crossing, Qld (21°10′15″S, 148°30′10″E), M.J. Tyler and K.R. McDonald, 26 Jan. 1984.
Paratypes: SAM R12590(12), Wyong, 1.6 km S, 9.6 km W Ulong, N.S.W., F. Parker, H. Ehmann and P. Krauss, 26 Jan. 1971; SAM R29597–98, Ourimbah Creek, N.S.W., M. Mahony, 3 Nov. 1981; SAM R29599–607 (topotypes); SAM R29608–13, Bellthorpe S.F., Qld (26°44′S, 152°36′E), K.R. McDonald, J.S. McEvoy and D.G. Crossman, 27 Feb. 1976; SAM R29614–16, Crows Nest Ntl Pk, Qld, K.R. McDonald, 14 Jan. 1974; SAM R29617, Mt Glorious, Qld, C.J. Limpus and K.R. McDonald, 20 Feb. 1974; SAM R29618, 2 km from Sunday Creek turnoff along Jimna/Bellthorpe Rd, Qld (26°42′S, 152°29′E), K.R. McDonald, 13 Dec. 1978; SAM R29619, nr Blue Lagoon Swamp, Moreton Id, Qld, K.R. McDonald, 16 Nov. 1976.

Uperoleia glandulosa Davies, Mahony & Roberts, 1985
Trans. R. Soc. S. Aust. **109**: 103.
Paratypes: SAM R27081–82, 3.2 km NE Wittenoom turnoff on Pt Hedland-Broome Rd, W.A., M. Mahony and J.D. Roberts, 10 Jan. 1983.

Uperoleia inundata Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 39.
Holotype: SAM R17182, Jabiru, East Alligator River Regn, N.T., G.A. Crook, 30.1.79.
Paratypes: SAM R16997, nr Mt Brockman, N.T., G.A. Crook, M. Davies, A.A. Martin and M.J. Tyler, 2 Dec. 1978; SAM R16999–17002, Jabiru Airstrip, N.T., G.A. Crook, 4 Dec. 1978; SAM R17182–90, 17216, Jabiru, N.T., G.A. Crook, 30 Jan. 1979; SAM R17191–92, Gulungul Swamp, nr Jabiru, N.T., G.A. Crook, 8 Jan. 1979; SAM R17193–94, 17217, Leanyer Swamp, Darwin, N.T., I. Morris, 31 Jan. 1979; SAM R17195–96, 5.7 km W Mary River Crossing, Arnhem Hwy, G.A. Crook, M. Davies, A.A. Martin and M.J. Tyler, 21 Feb. 1979.

Uperoleia lithomoda Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 43.
Paratypes: SAM R17008–10, Spillway Bridge, 11.5 km NE Lake Argyle Tourist Village, L. Argyle, W.A. (16°02′S, 128°47′E), M. Davies, A.A. Martin and M.J. Tyler, 20 Feb. 1977 (topotypes); SAM R17012, Kununurra, W.A., M. Davies, A.A. Martin and M.J. Tyler, 23 Feb. 1977; SAM R17011, Gt Northern Hwy, 81 km S Duncan Hwy junction, W.A., M. Davies, A.A. Martin and M.J. Tyler, 24 Jan. 1978; SAM R17220, Granite Creek, 14.1 km NE Lake Argyle Tourist Village, L. Argyle, W.A., M. Davies, A.A. Martin and M.J. Tyler, 22 Feb. 1977; SAM R17179–80, 17218, Arnhem Hwy at Fogg Dam turnoff, N.T., 24 km ESE Darwin, I. Morris, 31 Jan. 1979; SAM R17181, 7 km W Mary R. Bridge, Arnhem Hwy, N.T., G.A. Crook, M. Davies, A.A. Martin and M.J. Tyler, 21 Feb. 1979.

Uperoleia littlejohni Davies, McDonald & Corben, 1986
Proc. R. Soc. Vict. **98**: 174.
Paratypes: SAM R29620–21, Gorge Creek, Qld (19°33′S, 143°56′E), A. Taplin, 18 March 1984; SAM R29622, Caerphilly Stn, Qld (21°03′S, 146°05′E), B.C. Lawrie, 3 March 1981; SAM R29623, Strathtay, Qld (20°57′S, 144°12′E), B.C. Lawrie, 24 Aug. 1984; SAM R29624, Amber Stn *ca* 1.6 km from French's Crossing on Lynd R., Qld, K.R. McDonald and S.K. Reardon, 15 Jan. 1980; SAM R29625–26, Walsh R., Watsonville, Qld (17°2′S, 145°18′E), J.W. Winter, 24 Dec. 1973.

Uperoleia martini Davies & Littlejohn, 1986
Trans. R. Soc. S. Aust. **110**: 129.
Paratypes: SAM R29648–50, 6 km NNE Yarram, Vic., M.J. Littlejohn and T.G. Littlejohn, 1 Dec. 1980; G.F. Watson and M.J. Littlejohn, 1 Oct. 1976.

Uperoleia micromeles Tyler, Davies & Martin. 1981
Aust. J. Zool., Suppl. (79): 46.
Holotype: SAM R17175, Tanami Desert, N.T. (28°38′S, 130°25′E), M. Gillam and I. Andrews, 18 Jan. 1978.
Paratypes: SAM R17176–78, 17221 (topotypes).

Uperoleia mimula Davies, McDonald & Corben, 1986
Proc. R. Soc. Vict. **98**: 178.
Paratypes: SAM R29627, Lannercost S.F., Qld, K.R. McDonald and P. Minton, 16 Feb. 1984; SAM R29628–40, Townsville Common, Townsville, Qld, B.J. Lyon, 9 March 1977, C.J. Limpus, K.R. McDonald, 10 Feb. 1977, K.R. McDonald, 25 Nov. 1985; SAM R29641, Bazant Outstation, Lakefield Ntl Pk, K.R. McDonald and B.J. Lyon, 23 Feb. 1981; SAM R29642, Weipa, Qld, K.R. McDonald, 3 March 1981; SAM R29643, Bamaga, Qld, B.J. Lyon and C.J. Limpus, 14 Dec. 1976; SAM R29644–45, Battery Stn, nr

Snake Creek, Qld (19°27′S, 145°39′E), B.C. Lawrie, 3 Dec. 1981; SAM R29646, base of Bluewater Range, K.R. McDonald, 3 Oct. 1983; SAM R29647, L. Louisa, Qld (19°54′S, 144°15′E), S. Garnett, 18 Aug. 1984.

Uperoleia minima Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 49.
Paratypes: SAM R17081, 17088–89, Amax Crusher Site, 5 km SW Mining Camp, Mitchell Plateau, W.A. (14°50′S, 125°50′E), M. Davies, A.A. Martin and M.J. Tyler, 31 Jan. 1978 (topotypes); SAM R17085–87, M. Davies, A.A. Martin and M.J. Tyler, 14–18 Feb. 1979 (topotypes).

Uperoleia talpa Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 52.
Paratype: SAM R17174, 24–41 km S Derby, W.A., M. Davies, A.A. Martin and M.J. Tyler, 13 Feb. 1979.

Uperoleia trachyderma Tyler, Davies & Martin, 1981
Trans. R. Soc. S. Aust. **105**: 149.
Holotype: SAM R20374, George Redman Causeway, 37 km N Elliot, N.T. (17°14′S, 133°28′E), M. Davies, A.A. Martin and M.J. Tyler, 16 Dec. 1980.
Paratypes: SAM R20375–76 (topotypes).

Uperoleia tyleri Davies & Littlejohn, 1986
Trans. R. Soc. S. Aust. **110**: 132.
Paratypes: SAM R29653–58, Narrabarba, A.C.T., M.J. Littlejohn and G.F. Watson, 24 Sept. 1985; SAM R29659, Cape Conran, Vic., M.J. Littlejohn and G.F. Watson, 26 Sept. 1985; SAM R29652, 7 km ENE Marlo, Vic., H.C. Gerhardt, 27 Nov. 1981.

Uperoleia variegata Tyler, Davies & Martin, 1981
Aust. J. Zool., Suppl. (79): 55.
= *Uperoleia lithomoda vide* Tyler, Davies & Watson (1987)
Paratypes: SAM R17197–215, 17219, Gibb River Stn, W.A. (16°26′S, 126°26′E), A.K. Lee, 10 June 1965 (topotypes).

Family **Microhylidae**

Aphantophryne sabini Zweifel & Parker, 1989
Amer. Mus. Novit. (2954): 4.
Paratypes: SAM R33505–6, Myola Guest House, 2080 m, 7 km S, 6 km W Mt Bellamy, Northern Province, Papua New Guinea, F. Parker, R.G. Zweifel and L.T. Penny, 8 Aug. 1987.

Barygenys cheesmanae Parker, 1936
Ann. Mag. nat. Hist. **17**: 74.
Paratype: SAM R9423, Mt Tafa, New Guinea, L.E. Cheesman, Feb. 1934.

Barygenys maculata Menzies & Tyler, 1977
J. Zool. Lond. **183**: 447.
Paratype: SAM R14001, within 1 km of type locality: approx. 3 km NW Agaun, 1500 m, Milne Bay Province, Papua New Guinea, J.I. Menzies, 8 Nov. 1974.

Cophixalus concinnus Tyler, 1979
Copeia **1979**: 119.
Paratypes: SAM R16375–76, Thornton Peake, 1250 m, Qld (16°12′S, 145°20′E), J.W. Winter, 14 Nov. 1973.

Cophixalus crepitans Zweifel, 1985
Bull. Amer. Mus. nat. Hist. **182**: 315.
Paratypes: SAM R23873, Rocky Scrub, 28 km NE Coen, 520–540 m, Qld (13°44°30″S, 143°20′30″E), J.W. Winter and R.G. Atherton, 15 May 1978; SAM R23874, Rocky Scrub, 29 km NE Coen, 520–540 m, Qld (13°44′30″S, 143°21′30″E), J.W. Winter and R.G. Atherton, 16 Nov. 1978; SAM R23875, Weather Stn, 19 km ENE Mt Croll, Qld (13°42′30″S, 143°18′30″E), R.G. Atherton, K.R. McDonald, P.A. Mathew and J.W. Winter, 16 March 1979.

Cophixalus exiguus Zweifel & Parker, 1969
Amer. Mus. Novit. (2390): 2.
Holotype: SAM R10311, Mt Hartley, 1800–2000 ft, Qld, F. Parker, 10 June 1968.
Paratypes: SAM R9796, 10035–40 (same data as holotype). (R9723 transferred to Museum of Natural History, University of Kansas. Now KU 153146.)

Cophixalus infacetus Zweifel, 1985
Bull. Amer. Mus. nat. Hist. **182**: 324.
Paratypes: SAM R23872, Henrietta Creek, Palmerston Ntl Pk, 360 m, Qld, K.R. McDonald and R.G. Atherton, 11 Feb. 1977; SAM R24080, Palmerston Ntl Pk, Qld, K.R. McDonald, 16 Feb. 1977.

Copiula fistulans Menzies & Tyler, 1977
J. Zool., Lond. **183**: 435.
Holotype: SAM R14497, approx. 11 km N Lae, Papua New Guinea, J.I. Menzies, 24 Sept. 1973.
Paratypes: SAM R5879, 6382–83, 14239–50, 14646, Martyr's Memorial School, Agenahambo nr Popondetta, B.J. Brock, 7 Oct. 1964; SAM R9443–48 (same locality), B. Kirke, 15 Feb. 1968.

Copiula minor Menzies & Tyler, 1977
J. Zool., Lond. **183**: 441.

Paratype: SAM R15245, Oirdamawa's Peak, Goodenough Id, Milne Bay Province, Papua New Guinea, J.I. Menzies, 29 Dec. 1975.

Copiula pipiens Burton & Stocks, 1986
Trans. R. Soc. S. Aust. **110**: 155.
Holotype: SAM R29779, Wirui, 1 km from Wewak, Papua New Guinea (3°35′S, 143°35′E), R. Stocks, 29 March 1983.
Paratypes: SAM R29780-82, taken with the holotype.

Copiula tyleri Burton, 1990
Trans. R. Soc. S. Aust. **114**: 87.
Paratype: SAM R33774, Mt Hunstein, 1220 m (4°31′S, 142°39′E), East Sepik Province, Papua New Guinea, R. Hoogland, 15 July 1966.

Hylophorbus rufescens extimus Zweifel, 1972
Bull. Amer. Mus. nat. Hist. **148**: 454.
Paratype: SAM R25315, Mt Riu, Sudest Id, Louisiade Archipelago, Milne Bay District, Papua New Guinea, Fifth Archbold Expedition, 23 Aug.-5 Sept. 1956.

Hylophorbus rufescens myopicus Zweifel, 1972
Bull. Amer. Mus. nat. Hist. **148**: 455.
Paratype: SAM R12534, Kulumadau, Woodlark Id, Milne Bay District, Papua New Guinea, Fifth Archbold Expedition, 1-22 Nov. 1956.

Phrynomantis humicola humicola Zweifel, 1972
Bull. Amer. Mus. nat. Hist. **148**: 471.
Paratypes: SAM R25303-04, South slope, Kotuni, 7000-8000 ft, Eastern Highlands, Papua New Guinea, H.M. Van Deusen, Sixth Archbold Expedition, 18 Aug. 1959.

Phrynomantis infulata Zweifel, 1972
Bull. Amer. Mus. nat. Hist. **148**: 476.
= *Mantophryne infulata* (Zweifel), *vide* Burton (1986: 415).
Paratype: SAM R25312, Arau, 1400 m, Kratke Mts, Eastern Highlands District, Papua New Guinea, H.M. Van Deusen, 13 Oct.-8 Nov. 1959. (Formerly AMNH 66685.)

Phrynomantis personata Zweifel, 1972
Bull. Amer. Mus. nat. Hist. **148**: 489.
Paratypes: SAM R5888, Jama, East Sepik District, Papua New Guinea, W. Ewers, 18 Oct. 1964; SAM R25313, Lumi, Sepik Province, 1750 ft, M. Loram, July-Aug. 1966.

Sphenophryne adelphe Zweifel, 1985
Bull. Amer. Mus. nat. Hist. **182**: 280.
Holotype: SAM R17344, Back Jungle, Croker Id, N.T., I. Morris, 23 Jan. 1979.
Paratypes: SAM R17345-46 (same data as holotype).

Sphenophryne dentata Tyler & Menzies, 1971
Trans. R. Soc. S. Aust. **95**(2): 79.
Holotype: SAM R12063, Alotau, Milne Bay, New Guinea, J.I. Menzies, 11 Nov. 1970.
Paratypes: SAM R11819-20 (same data as holotype), J.I. Menzies, 6-12 Nov. 1970.

Xenobatrachus multisica Blum & Menzies, 1989
Alytes **7**(4): 150.
Paratypes: SAM R31822-23, Eipomale, Irian Jaya, 1800 m, J.P. Blum, April-June 1976.

Xenobatrachus subcroceus Menzies & Tyler, 1977
J. Zool., Lond. **183**: 450.
Paratype: SAM R14002, approx. 11 km N Laè, Papua New Guinea, J.I. Menzies, 9 March 1974.

Xenorhina parkerorum Zweifel, 1972
Bull. Amer. Mus. nat. Hist. **148**: 539.
Paratypes: SAM R6404-05, Okfekaman, nr Telefomin, West Sepik District, Papua New Guinea, 5500 ft, B. Craig, 29 Nov. 1964.

Xenorhina similis Zweifel, 1972
Bull. Amer. Mus. nat. Hist. **148**: 541.
Paratype: SAM R25311, L. Habbema, Papua New Guinea, W.B. Richardson, 9 Nov. 1938.

Family **Ranidae**

Cornufer ingeri Brown & Alcala, 1963
Copeia **1963**(4): 672.
= *Platymantis ingeri* (Brown & Alcala), *vide* Zweifel (1967: 120).
Paratypes: SAM R8808, Cantaub area, Bohol Id, Philippines, A.C. Alcala, 4 May 1962; SAM R13606, Dusita area, Bohol Id., Philippines, A. Alcala, 28 April 1961.

Platymantis akarithymus Brown & Tyler, 1968
Proc. biol. Soc. Wash. **81**: 76.
Holotype: SAM R7073, Pomogu, 11 km NW Kandrian, New Britain, M.J. Tyler, 31 Jan. 1966.
Paratypes: SAM R6982 (same data as holotype); SAM R7066, R7082, near Malassait, approx. 65 km W Rabaul, New Britain, M.J. Tyler, Jan. 1966.

Platymantis mimicus Brown & Tyler, 1968
Proc. biol. Soc. Wash. **81**: 74.
Holotype: SAM R6868, Numundo Plantation, Willaumez Peninsula, New Britain, M.J. Tyler, 19 Jan. 1966.
Paratypes: SAM R7064 (same data as holotype); SAM R7069, Pomugu 11 km NW Kandrian,

New Britain, M.J. Tyler, 29 Jan. 1966; SAM R6864, Gazelle Peninsula, New Britain, M.J. Tyler, 25 Jan. 1966.

Platymantis rhipiphalcus Brown & Tyler, 1968
Proc. biol. Soc. Wash. **81**: 77.
Holotype: SAM R7071, nr Pomogu, approx, 11 km NW Kandrian, New Britain, M.J. Tyler, 31 Jan. 1966.
Paratype: SAM R7078, San Remo Plantation, Willaumez Peninsula, New Britain, M.J. Tyler, 20 Jan. 1966.

Platymantis papuensis schmidti Brown & Tyler, 1968
Proc. biol. Soc. Wash. **81**: 85.
= *Platymantis schmidti* Brown & Tyler, *vide* Menzies (1982).
Holotype: SAM R7618, Talasea, Willaumez Peninsula, New Britain, M.J. Tyler, 11 Jan, 1966.
Paratypes: SAM R6762-68, 6772-93, 6795, 6801, 6803-07, 6809-13, 6815-16, 6858-60, 6862, 6869, 6912-13, 6915, 6922-28, 7061, 7070, 7080, 7085, 7088, 7089, 7093, 7095, 7097, 7101-04, 7106, 7109, 7115, Willaumez Peninsula, New Britain, M.J. Tyler, Jan. 1966; SAM R7615, 7617-23, 7625-37, 7639-47, 7649-74, 7677-78, Baining Ranges, Gazelle Peninsula, New Britain, M.J. Tyler, 11 Jan. 1966; SAM R7043, 7045, 7099, 7132, 7134-37, 7139, 7147-48, 7151, Kerevat, Gazelle Peninsula, New Britain, M.J. Tyler, Jan.-Feb. 1966. (R7616, 7638, 7648 transferred to Museum of Natural History, University of Kansas. Now KU 153147-49.)

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A REVIEW OF THE GENUS *ISOPEDA* L. KOCH (HETEROPODIDAE: ARANEAE) IN AUSTRALASIA WITH DESCRIPTIONS OF TWO NEW GENERA

D.B. HIRST

HIRST, D.B. 1990. A review of the genus *Isopeda* L. Koch (Heteropodidae: Araneae) in Australasia with descriptions of two new genera. *Rec. S. Aust. Mus.* 24(1): 11-26.

The genus *Isopeda* L. Koch is redefined. *Holconia* Thorell is reinstated. Type species of those genera are redescribed. Two new genera, *Isopedella* and *Beregama* are described and a valid taxon for each is selected as type species and redescribed. All nominal Australasian species are allocated to their respective genera and synonyms of type species noted. Three species are excluded from the above genera. A further four are considered nomina dubia. Distribution of the genera is discussed briefly.

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The broad definition by Koch (1875) of the genus *Isopeda* has never been questioned. The similar appearance of included species combined with a lack of any detailed study of the genitalia and corresponding morphology resulted in a heterogeneous assembly of taxa and allowed the inclusion of *Holconia* Thorell by Hogg (1903) to be readily accepted. The present paper is a preliminary work on the genus *Isopeda* with the recognition as genera of four major species groups currently contained within it. It is the third part of a revision of the Australian Heteropodidae excluding *Heteropoda* Latreille, 1804, and provides clarification of the taxa included in the genus *Isopeda* in the interim, until species involved are revised.

L. Koch (1867) described *Ocypete vasta* and *Delena immanis*. Thorell (1870) described a new genus and species, *Voconia insignis*, and also the species *Heteropoda pessleri*. L. Koch (1875) added *V. dolosa* and transferred *Delena immanis* to *Voconia*. Koch also transferred *H. pessleri* and *O. vasta* to his new genus *Isopeda* selecting *vasta* as type species. Eight new species, *aurea, conspersa, cordata, flavibarbis, flavida, hirsuta, robusta* and *villosa* were also described. Thorell (1877) found *Voconia* pre-occupied and replaced that name with *Holconia*. Thorell (1881) described *Isopeda deianira, I. herculea* and *Holconia subdola*. Hogg (1896) described *I. horni* which he subsequently (Hogg, 1903) transferred to *Pediana* Simon, 1880. Hogg (1903) in his revision of the Australasian Heteropodidae synonymised *Holconia* with *Isopeda* and described eleven new species, *ardrossana, frenchi, leai, leishmanni, montana, pengellya, pococki, saundersi, tepperi, tietzi* and *woodwardi*. Strand (1907) described *I. maculigastra* and *I. vastata*. Simon (1908) described *cana, cerussata, nigrigularis* and *woodwardi*. As the latter was a homonym, the species was renamed *I. simoni* by Rainbow (1911). Strand (1911) described *I. terangana* and later Strand (1913) added *I. conspersula, I. immigrans, I. inola* and *I. herculeana*. Rainbow (1917) described *I. gloriosa*. Lastly Chrysanthus (1965) described *I. goliath* and *I. meraukensis*.

Thus, 41 nominal species are considered here from the Australasian region (Table 1) excluding *I. horni* which was previously (see above) transferred to *Pediana*. A further eight species outside this region are not considered in this review and it is likely that many, if not all, belong to other genera.

Materials and Methods

Only the nominated type species is treated for each genus. New synonymies and lists of material examined, other than for material mentioned here, will be given in revisions of the genera which are in preparation. Non-type material is used where types are unavailable and for drawings of the internal female genitalia, which are dissected and cleared in lactic acid. Setae are generally omitted from illustrations. Descriptive format follows Hirst (1989a, 1989b). Leg ratio is the leg length divided by carapace length. Other leg comparisons are made with those legs held together at right angles to the body. Descriptions of tibial apophysis shape are given from the retrolateral aspect. Median ocular quadrat (MOQ) measurements are abbreviated to aw (anterior width), pw (posterior width) and l (length). Measurements are given in millimetres. Localities are abbreviated as ACT, Australian Capital Territory; NSW, New South Wales; Q, Queensland; SA, South Australia; V, Victoria; WA, Western Australia. Further acronyms are AM, Australian Museum, Sydney; BMNH, British Museum (Natural History), London; NHMW,

TABLE 1.

Nominal species	Revised status, this work
Ocypete vasta L. Koch, 1867	= *Isopeda vasta* (L. Koch)
Delena immanis L. Koch, 1867	= *Holconia immanis* (L. Koch)
Voconia insignis Thorell, 1870	= *Holconia insignis* (Thorell)
Heteropoda pessleri Thorell, 1870	= *Isopedella pessleri* (Thorell)
Voconia dolosa L. Koch, 1875	= nomen dubium
Isopeda aurea L. Koch, 1875	= *Beregama aurea* (L. Koch)
Isopeda conspersa L. Koch, 1875	= *Isopedella conspersa* (L. Koch)
Isopeda cordata L. Koch, 1875	= *Beregama cordata* (L. Koch)
Isopeda flavibarbis L. Koch, 1875	= *Beregama aurea* (L. Koch)
Isopeda flavida L. Koch, 1875	= *Isopedella flavida* (L. Koch)
Isopeda hirsuta L. Koch, 1875	= *Holconia hirsuta* (L. Koch)
Isopeda robusta L. Koch, 1875	= nomen dubium
Isopeda villosa L. Koch, 1875	= *Isopeda villosa* L. Koch
Isopeda deianira Thorell, 1881	= ? *Olios deianira* (Thorell)
Isopeda herculea Thorell, 1881	= *Beregama herculea* (Thorell)
Holconia subdola Thorell, 1881	= *Holconia subdola* Thorell
Isopeda ardrossana Hogg, 1903	= *Isopedella ardrossana* (Hogg)
Isopeda frenchi Hogg, 1903	= *Isopedella frenchi* (Hogg)
Isopeda leai Hogg, 1903	= *Isopedella leai* (Hogg)
Isopeda leishmanni Hogg, 1903	= *Isopeda leishmanni* Hogg
Isopeda montana Hogg, 1903	= *Isopeda montana* Hogg
Isopeda pengellya Hogg, 1903	= *Isopeda pengellya* Hogg
Isopeda pococki Hogg, 1903	= nomen dubium
Isopeda saundersi Hogg, 1903	= *Isopedella saundersi* (Hogg)
Isopeda tepperi Hogg, 1903	= *Isopedella tepperi* (Hogg)
Isopeda tietzi Hogg, 1903	= *Isopedella tietzi* (Hogg)
Isopeda woodwardi Hogg, 1903	= *Isopeda woodwardi* Hogg
Isopeda maculigastra Strand, 1907	= *Isopedella maculigastra* (Strand)
Isopeda vastata Strand, 1907	= nomen dubium
Isopeda cana Simon, 1908	= *Isopedella cana* (Simon)
Isopeda cerussata Simon, 1908	= *Isopedella cerussata* (Simon)
Isopeda nigrigularis Simon, 1908	= *Holconia nigrigularis* (Simon)
Isopeda woodwardi Simon, 1908	= *Holconia simoni* (Rainbow, 1911)
Isopeda terangana Strand, 1911	= *Isopedella terangana* (Strand)
Isopeda conspersula Strand, 1913	= *Isopeda vasta* (L. Koch)
Isopeda immigrans Strand, 1913	= *Polybetes pythagoricus* Holmberg, 1874
Isopeda inola Strand, 1913	= *Isopedella inola* (Strand)
Isopeda herculeana Strand, 1913	= *Beregama aurea* (L. Koch)
Isopeda gloriosa Rainbow, 1917	= *Delena gloriosa* (Rainbow) nov. comb.
Isopeda goliath Chrysanthus, 1965	= *Beregama goliath* (Chrysanthus)
Isopeda meraukensis Chrysanthus, 1965	= *Isopedella meraukensis* (Chrysanthus)

Naturhistorisches Museum, Wien, Austria; NHRM, Naturhistoriska Riksmuseet, Stockholm, Sweden; QM, Queensland Museum, Brisbane; SAMA, South Australian Museum, Adelaide; SMF, Natur-Museum Senckenburg, Franfurt-am-Main, Germany; SMNS, Stadtliches Museum für Naturkunde, Stuttgart, Germany; ZMH, Zoologisches Museum, Hamburg, Germany.

Discussion of Diagnostic Morphological Features

The generic diagnosis given for *Isopeda* by Koch (1875) contained few characters or character combinations, which are found only in that genus. That diagnosis includes genera found in New Guinea which are not dealt with here. Apart from the reference to the flattish carapace it could equally include *Neosparassus* Hogg, 1903. Also characters used by early workers, leg spines, number of cheliceral teeth, and to some extent, eye position, have been found in this study to be either subject to bilateral variability or to variation. Sternum colour is useful at species level and will be dealt with fully in future revisions.

Although represented by two different genitalia forms, the congeneric relationship of the two species groups of *Pediana* was supported by other characters (Hirst, 1989b). However, the species groups of *Isopeda* (sensu lato) have conflicting character states in addition to those of the genitalia. Two 'outlying' groups are easily removed from *Isopeda* and raised to generic level. These are *Holconia* and *Beregama*. Using characters which enable reinstating the genus *Holconia* and erection of the new genus *Beregama*, a further new genus, *Isopedella*, can be removed from *Isopeda* leaving three minor species groups which feasibly belong in the latter genus.

Table 2 summarises the characters for each genus in cladistic form using apomorphic characters but without the aid of computer analysis. The embolus, conductor and embolar base, which is basically an extension of the tegulum, largely obscure the tegulum. The latter partly extends pro-distally into the distal half of the cymbium and except in *Holconia*, is ventrally modified to form a tegular apophysis. The ventral edge of the tegular apophysis of *Isopeda* (Fig. 3) is usually close to the embolar base and has a flattish posterior face. The tegular apophysis of *Isopedella* often has the ventral edge spaced further from the embolar base with the posterior face concave (Fig. 13). Also, the apophysis often extends further mesally. *Beregama* has a weakly modified or rounded tegular apophysis (Fig. 18). The tegulum of *Holconia* is not modified to form an apophysis, this being replaced by a subembolic apophysis at the junction of the tegulum and embolar base (Fig. 8).

Adjacent to the junction of the embolar base and the embolus proper a sclerite occurs in *Isopeda* (Fig. 1) which presumably has its homology in the median apophysis of *Pediana* (Hirst, 1989b), but as it is not truly representative of an apophysis it is here termed the embolic sclerite. The embolic sclerite is reduced in several species of *Isopeda* where it is paralleled by one species of *Holconia*. In other *Holconia* species and also *Beregama* the

TABLE 2. Summary of diagnostic characters.

Apomorphic character state	Beregama	Isopeda	Holconia	Isopedella
1 Tegular apophysis extends mesally				*
2 Tibial apophysis narrow doubly curved				*
3 Legs I and II subequal				*
4 2nd embolic coil larger than 3rd				*
5 Embolar base large retrolaterally				*
6 Leg spination relatively greater				*
7 Chelicerae never enlarged distally			*	*
8 Embolar base without granulations			*	*
9 Embolar base with mesal ridge			*	
10 Epigynal sclerite present			*	
11 Subembolic apophysis present			*	
12 Embolar flange mesal, short, low			*	
13 Spermathecal sacs shortish, curved			*	
14 Tibial apophysis lanceolate			*	
15 Tibial apophysis angled to venter		*		
16 Spermathecal sacs shortish, straight		*		
17 Epigynum narrow anteriorly, broad posteriorly		*		
18 Embolic sclerite adjacent granulate area		*		
19 Embolus constricted ¼ to ½ turn from tip		*	*	
20 Anterior eye spacings equal		*	*	
21 Carapace low, flattish above		*	*	
22 Recurved posterior eye row		*	*	
23 Spermathecal sacs not arced to anterior		*	*	*
24 Clypeus ½ diameter of AME or less		*	*	*
25 Embolar base connects embolus more proximally	*		*	
26 Embolic flange low prodistal or absent	*			*
27 AME-ALE width ½–⅔ width of AME-AME	*			*
28 Spermathecal sacs, when present, tubular	*	*	*	*
29 Embolus in single stack of 6 to 15 coils	*	*	*	*
30 Conductor originates from retro-proximal	*	*	*	*
31 Fossa lacks setae	*	*	*	*
32 Fossa with sclerotised lateral rims	*	*	*	*
33 Conductor fills 'gap' left by last embolus coil	*	*	*	*

(The combination of characters 29–33 diagnose the above genera from other closely related Australian heteropodid genera.)

sclerite is recessed to unite with the embolus more proximally (Fig. 6) and is not distinct as a separate sclerite. The embolic sclerite is obscured or absent in *Isopedella*.

The embolar base is largest in *Isopedella* where it overhangs part of the embolus retrolaterally (Fig. 11). *Holconia* species have a reduced embolar base with a prominent mesal ridge (Fig. 6). The embolar base is least developed in *Beregama*. Small granulations (Fig. 1) are present on the embolar base of *Isopeda* and *Beregama*. Granulations are also found in *Neosparassus* (unpublished data). Their significance is unknown. One species of *Holconia*, which has the embolic sclerite similar to *Isopeda* (see above), has ridges on the embolar base apparently derived from the granulations but further discussion is withheld for a paper on *Holconia* (in prep.). A flange is present on the distal margin of the embolar base (Figs 1, 3) but absent or low in some species of *Isopedella* and *Beregama*. A low, short flange in *Holconia* is positioned more mesally having been displaced by the subembolic apophysis.

The embolus rises from the embolar base and tegulum retro-distally, arcing around the tegulum proximally before continuing prolaterally into the distal half of the cymbium. Here the embolus forms a single conical stack of six to fifteen coils. The conductor originates within the embolar base and emerges proximally, running adjacent to the inner side of the embolus prolaterally then under the first coil of the embolar stack. Here it spirals tightly in cylindrical form, with the number of turns somewhat corresponding to that of the embolus, before expanding to fill the gap left by the last embolar coil and supporting the embolus tip. The embolus tapers gradually to the tip in *Isopedella* and *Beregama* but is often constricted ½ to ¼ turn from the tip in *Isopeda* (Fig. 1) and some *Holconia*. In all genera except *Isopedella* the first and second embolic coils are smaller than the third and the first coil is not easily seen in ventral view.

The distal retrolateral tibial apophysis is subequal in length to the tibia and supported by a mesal membranous thickening attached to the base which in *Holconia* and some *Isopeda* forms a smooth,

somewhat continuous line with the apophysis. In *Isopeda* the tibial apophysis turns towards the venter above the base and is angular in shape (Fig. 2). It is laterally flattened and often serrated on its dorsal edge. *Isopedella* has a more rounded tibial apophysis narrower at the base and gradually tapered with an additional forward curve (Figs 11–12). *Holconia* has a lanceolate shaped apophysis (Fig. 7), somewhat laterally flattened and directed to the anterior. The relatively shorter tibial apophysis in *Beregama* is straight or more usually, curved much as in *Isopedella*, but then broader midlength (Fig. 17) or, throughout.

The lateral rim and fossa of the epigynum lack setae. The large fossa is overhung laterally by a sclerotised rim which is narrowly divided anteriorly. The rim is relatively flat and the fossa not deeply recessed except in *B. aurea*, in which the rim slopes steeply towards a sunken fossa. The broader posterior margin (narrower in some *Beregama)* turns mesally against the epigastric furrow. *Isopeda* has an ovoid shaped epigynum (Fig. 4) often with the fossa bulged at the anterior margin, that of *Isopedella* is somewhat narrower, bell-shaped or ovate (Fig. 14). The epigynum of *Holconia* is bell-shaped (Fig. 9), or in one species rounded, but in both cases, broader anteriorly than other genera except *H. immanis* in which the epigynum may be relatively smaller. *Beregama* species have a rounded or horseshoe shaped epigynum accentuated by the continuation of sclerotisation across the anterior margin except *B. aurea* which has a bell-shaped epigynum (Fig. 19). A sclerite, termed the epigynal sclerite, on the postero-lateral corner of the epigynum extends partly over the fossa in *Holconia* (Figs 9–10).

Internally the vulva comprises paired insemination ducts coiled around central spermathecal ducts which lead back adjacent to anterior part of fossa. Here there are usually tubular spermathecal sacs, extending medially under fossa, moderately long to short and occasionally 'elbow-like' in *Isopeda* (Fig. 5), shortish and curved in *Holconia* (fig. 10), long and arced forward to the anterior in *Beregama* (Fig. 20) but absent (Fig. 15) or 'elbow-like' in *Isopedella*. The spermathecae loop to anterior of fossa then continue under the sclerotised rim as fertilization ducts to posterior of epigynum.

Relative lengths of anterior legs vary both intraspecifically and from bilateral variability, but in most *Isopeda* and *Holconia* leg II is much longer than leg I with the latter reaching about mid-length along metatarsus II or at least not reaching the distal end of the metatarsus. *Beregama* generally have leg I reaching almost to, or to the distal end of metatarsus II while leg I of *Isopedella* reaches beyond metatarsus II to mid-length of tarsus II. *Isopedella* females have relatively shorter legs than females of other genera. Spination of legs is lowest in some *Isopeda* and greatest in *Isopedella*.

The carapace is generally low and flattish in *Isopeda* and *Holconia* but higher and convex in *Isopedella* and *Beregama*. The clypeus width of *Beregama* is often subequal to the diameter of an AME but half the width or less of an AME in other genera. Anterior eye spacings are rather equal in *Isopeda* and *Holconia*, subequal in *Beregama* while *Isopedella* have the AME-ALE width about half that between the AME. A line drawn behind the posterior eye row is slightly to distinctly recurved in *Isopeda* and *Holconia* but relatively straight in the other genera. Males of *Isopeda* and *Beregama* often have the chelicerae retro-distally elongated with the distal tooth largest, angled more anteriorly and well spaced from the subdistal tooth and fang base. The remaining genera lack modified chelicerae and the distal retromarginal tooth is usually smaller than the subdistal tooth.

The dorsal pattern of the abdomen is relatively constant in each genus. *Isopeda* usually have three or four pairs of blackish spots with the middle pairs elongated and often joined. Juveniles of some species have pairs of spots which are often lacking in adults. *Isopedella* may be similar to *Isopeda* but with usually two unjoined pairs of spots. This may be supplemented or replaced by a posterior folium, or by irregular spots formed by clusters of brownish setae. *Holconia* has a pattern of large brownish patches and often a yellow-brown or black anterior streak. Two or three pairs of spots may be present. *Beregama* is without a well defined pattern except for a folium in *B. cordata*.

The genera *Isopeda* and *Beregama* appear to contain relict species. *Beregama* is closely related to *Typostola* and *Zachria*. It has likely evolved from that stock rather than from within *Isopeda*. This is supported by the female spermathecae shape, the recessed fossa of *B. aurea* and by two unnamed species of uncertain generic placement having a male palp structure intermediate between *Typostola* and *Beregama* (unpubl. data). *Isopeda* is considered to have given rise to the more derived genera, *Isopedella* and *Holconia* following xeric events. These derived genera have successfully invaded the arid areas of Australia. The genera are not known to occur in Tasmania while *Beregama* and *Isopedella* are found in New Guinea.

Key to the Genera Previously Included in *Isopeda*

1 — Carapace flattened, or low and flattish medially. Anterior eyes equally spaced.....2
— Carapace convex. Anterior eyes not equally spaced 3

2 — Dorsal abdomen with 3 or 4 pairs of blackish spots, occasionally indistinct but usually without additional pattern. Male palpal tibial apophysis angled towards venter from above base and angular in shape (Fig. 2). Embolic sclerite present with adjacent granulated area on embolar base. Female epigynum ovoid, fossa narrow anteriorly, usually at least twice as broad posteriorly (Fig. 4). Spermathecal sacs shortish and straight but may be 'elbow-like' (Fig. 5)..... .....*Isopeda* L. Koch

— Dorsal abdomen with large dark brown or blackish patches in addition to 2 or 3 pairs of indistinct spots. Male palpal tibial apophysis lanceolate, anteriorly directed (Fig. 7). Subembolic apophysis between tegulum and embolar base (Fig. 8), tegular apophysis absent. Female with epigynal sclerite (Fig. 9). Spermathecal sacs shortish, usually curved (Fig. 10). .....*Holconia* Thorell

3 — Clypeus less than half width of AME. Male palpal tibial apophysis narrow, doubly curved, gradually tapered (Fig. 12). Embolar base broad, produced over embolus retrolaterally. Tegular apophysis extended distally and mesally usually with concave posterior face. Female epigynum relatively narrow, bell-shaped or ovate (Fig. 14). Spermathecal sacs absent (Fig. 15), rarely 'elbow-like'..... .....*Isopedella* gen. nov.

— Clypeus greater than half width of AME. Male palpal tibial apophysis straight and thin or doubly curved and, at least, broadest mid-length (Fig. 17). Tegular apophysis reduced or obscured. Female epigynum heavily sclerotised anteriorly, horse-shoe shaped or with broadly rounded posterior corners (Fig. 19) and fossa recessed. Spermathecal sacs long, curved to anterior (Fig. 20)..*Beregama* gen. nov.

Isopeda L. Koch

Isopeda L. Koch, 1875: 678.
Isopoda: Thorell, 1881: 293.

Type species:
Ocypete vasta L. Koch, 1867 by original designation.

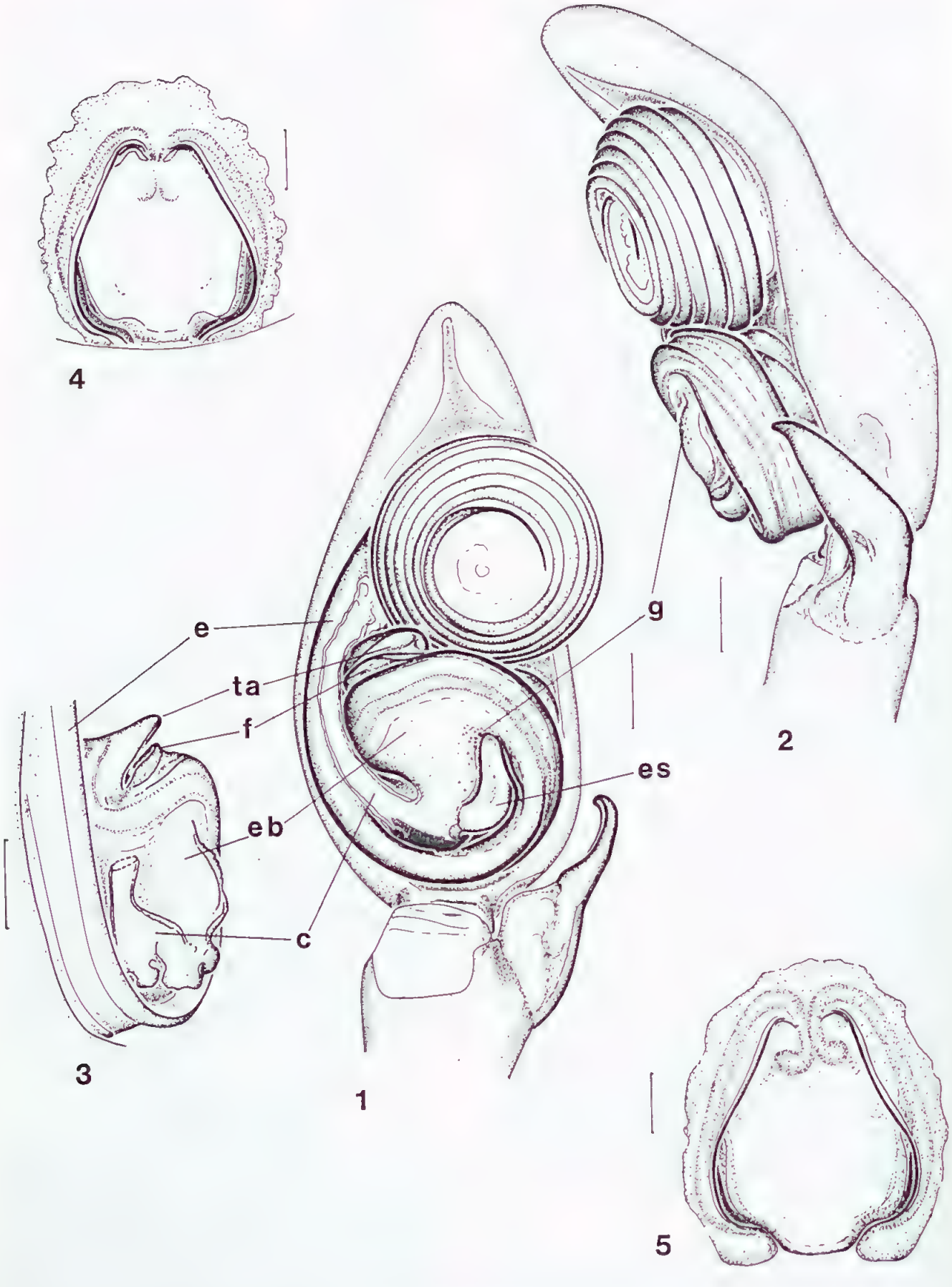
Diagnosis
Male palpal tibial apophysis angled towards venter above base and angular in shape, often serrated on dorsal edge. Female fossa anteriorly narrow, usually at least twice as broad posteriorly. Spermathecal sacs moderately long to short or 'elbow-like'.

Description
Carapace low, flattish medially to very flattened, length equals 4.5–8 times height. Anterior eyes rather equally spaced. Distance between PME subequal or greater than between PME-PLE. Line drawn behind posterior eyes recurved, rarely straight. Clypeus about half diameter or less of AME. Chelicerae may be ovoid, glabrous with some short blunt or swollen-tipped setae, or with relatively straight retrolateral side and long tapered setae. In the latter case the male may have chelicerae modified, extended retro-distally with distal tooth often angled to anterior, large and well spaced from others. Leg I, when outstretched alongside leg II, reaches from mid-length of metatarsus II to towards distal end of metatarsus. Distal margin of coxa I occasionally with a comb-like arrangement of short blunt-tipped setae. Palp femur and coxa I may have ventral stout bristles. Abdomen usually marked dorsally with four pairs of black spots, median pairs joined or narrowly separated. Male palpal tibia with large, often broad, laterally flattened retrolateral apophysis angled towards venter just above base, angular in shape, dorsal edge often serrated. Embolus coiled seven to eleven times, constricted ¼ to ½ turn from tip. Embolar base with large distal flange. Embolic sclerite large and prominent or smallish and partly overhung by the granulate area of the embolar base. Tegular apophysis with flattish posterior face, ventral edge extending to adjacent flange on embolar base. Female epigynum ovoid, lateral rims often relatively straight, diverging gradually from narrow emarginate and occasionally bulged anterior, usually at least twice as broad posteriorly. Fossa usually well separated from lateral rim at concave posterior corners. Spermathecal sacs moderately long, relatively straight to short and 'elbow' shaped, rarely absent, most often shortish.

Species included
Isopeda leishmanni Hogg, 1903, *I. montana* Hogg, 1903, *I. pengellya* Hogg, 1903, *I. vasta* (L. Koch, 1867), *I. villosa* L. Koch, 1875 and *I. woodwardi* Hogg, 1903. Several unnamed species are known. Distribution of *Isopeda* is from south-eastern Queensland along the east coast to south-eastern SA and south-western WA. It is found inland in areas with over 400 mm annual rainfall in NSW and V. Two species may be relict with one confined to alpine areas of V and NSW, the other to the Lamington Plateau in Q.

Isopeda vasta (L. Koch)
(Figs 1–5, Table 3)

Ocypete vasta L. Koch, 1867: 207. Koch described a female from Brisbane Q., deposited in NHMW. One female (Nr 1882.II.6), examined, in the collection of NHMW, was apparently brought from the Godeffroy Museum, Hamburg, as was the holotype. Although not labelled as type, its measurements are nearer to that of the holotype as stated by Koch (1867) than the following 'syntypes' in regard to leg lengths and if the carapace length is taken to include the forward extension of the chelicerae.



FIGURES 1-5. *Isopeda vasta* (L. Koch). 1-2, left palpal tibia and tarsus of male QM S15567: 1, ventral; 2, retrolateral. 3, tegular apophysis and embolar base, prolateral, distal part of conductor not drawn. 4, epigynum of female NHMW 1882.II.6. 5, vulva of female QM S15568, ventral. Scale lines 0.5 mm. c, conductor; e, embolus; eb, embolar base; es, embolic sclerite; f, flange; g, granulations; ta, tegular apophysis.

Isopeda vasta: L. Koch, 1875: 679. Two females labelled 'Syntypes', Brisbane, Queensland, ZMH (Mus. Godeffroy Nr 298a and Nr 10299), examined, probably formed the basis of Koch's redescription in 1875, and the syntype designation is invalid. A male described by Koch (1875) has not been located. It also is not a valid type.
Isopeda conspersula Strand, 1913: 610. Holotype ♀, Queensland, SMF 4644, examined. **New synonymy.**

Female NHMW 1882.II.6
CL 9.2, CW 8.6. AL 13.5, AW 10.7.

Colour in alcohol: Carapace orange-red, caput reddish. Chelicerae red, darker retrolaterally. Anterior legs with orange-red femora and patellae, distal segments reddish, posterior pairs yellow-orange. Femur I with basal prolateral blackish patch. Coxae yellowish. Maxillae and labium red-brown, maxillae with blackish retromargin. Sternum red-brown, long yellow-brown setae. Abdomen creamish-grey, with brown setae forming 2 pairs of spots. Venter yellowish with thin transverse patch of brown setae posterior to epigastric groove. Carapace: low, sides rounded, flattish above. Eyes: AME 0.54. AME: ALE: PME: PLE = 1: 1.22: 0.66: 0.98. Interspaces: AME-AME 0.66, AME-ALE 0.70, PME-PME 1.85, PME-PLE 1.89, AME-PME 0.96, ALE-PLE 1.19. MOQ, aw: pw: 1 = 2.69: 3.19: 2.67. Width of clypeus 0.55. Chelicerae glabrous, geniculate at base, swollen on retrolateral side. Some short blunt-tipped setae near base, promargin and around fang base. Retrolateral teeth 4, proximal tooth small, others sub-equal, closely spaced. Sternum L 4.6, W 3.8. Legs: (Table 3) Leg II longer than leg I, ratios 3.9, 3.5 respectively. Trochanter I apically with short setae (*ca* 0.4) resembling a comb. Spination: Legs I and II, fe d2 p3 r3, pa p1 r1, ti d2 p2 r2 v6, me p2 r2 v4. Leg III, same, but ti d1. Leg IV, fe d2 p3 r1, pa p1, ti p2 r1 v6, me p4 r4 v4. Palp, fe d1 + 4 apically in transverse row, pa p1 r1, ti d1 p3 r2, ta p3 r2. Epigynum: (Figs 4–5) Lateral rim narrowly rounded anteriorly then diverging to near posterior before curving mesally. Anterior part of fossa emarginate, raised. Spermathecal sacs of QM S15568 (Browns Plains, Q) 'elbow-like'.

Male QM S15567 (Boondall, Q.) as female except as follows:
CL 8.8, CW 8.2. AL 9.2, AW 6.4.

Colour in alcohol: Carapace and legs yellow-brown. Maxillae and labium brown. Sternum brown. Abdomen yellow-brown with brown anterior streak. Eyes: AME 0.58. AME: ALE: PME: PLE = 1: 1.03: 0.66: 0.96. Interspaces: AME-AME 0.52, AME-ALE 0.52, PME-PME 1.52, PME-PLE 1.38, AME-PME 0.69, ALE-PLE 0.79. MOQ, aw: pw: 1 = 2.41: 2.79: 2.21. Width of clypeus 0.45. Chelicerae glabrous, geniculate. Few short blunt-ended setae around fang base. Retromargin of fang groove with 5 teeth, distal tooth barely larger than subdistal tooth. Sternum L 4.6, W 3.9. Legs: (Table 3) Leg II longer than leg I, ratios 5.1, 4.3 respectively. Trochanter of leg I apically with comb of short setae (*ca* 0.3). Spination: Leg IV, ti d1 r0 (on left), me r2 (3 on left) v4. Palp, ti r1. Palp: (Figs 1–3) Tibial apophysis equal in length to tibia. Broad at base, angled towards venter just above base, angular in form to apex, laterally flattened, serrated on dorsal edge. Embolus with 7½ coils, sharply constricted then thinly tapered for the final half turn to tip. Embolar base with elongate embolic sclerite, adjacent to which are numerous granules. Tegular apophysis with well defined ridge, almost touching flange on embolar base for part of its length.

Distribution

I. vasta occurs in south-east Queensland and north-east NSW.

Holconia Thorell

Voconia Thorell, 1870: 382.
Holconia Thorell, 1877: 485 (nom. nov. for *Voconia*; preoccupied).
Isopeda: Hogg, 1903: 429.

Type species

Voconia insignis Thorell, 1870 by original designation and monotypy.

Diagnosis

Male palpal bulb with subembolic apophysis

TABLE 3. Leg measurements of *Isopeda vasta* (L. Koch), female NHMW 1882.II.6 with male QM S15567 in parentheses.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	9.0 (10.5)	4.7 (4.5)	7.7 (10.0)	8.4 (10.3)	2.6 (2.8)	32.4 (38.1)
II	10.3 (12.6)	5.0 (5.0)	9.0 (12.3)	9.2 (11.9)	2.6 (3.0)	36.1 (44.8)
III	7.6 (9.3)	3.5 (3.8)	6.0 (8.4)	5.8 (7.4)	2.2 (2.1)	25.1 (31.0)
IV	8.0 (9.7)	3.3 (3.5)	6.3 (8.0)	6.8 (8.7)	2.3 (2.3)	26.7 (32.2)
Pa	3.2 (3.2)	1.6 (1.5)	1.9 (1.5)	— —	3.6 (4.3)	10.3 (10.5)

between tegulum and embolar base. Tegular apophysis absent. Female epigynum broad with postero-lateral convex epigynal sclerite extending partly over fossa. Spermathecal sacs shortish, curved.

Description

Carapace low, flattened, length equals 6–8 times height, often with a pattern. Anterior eyes equally spaced. Distance between PME subequal to greater than that between PME-PLE. PME almost half of ALE, low. Line drawn behind posterior eye row is recurved. Narrow clypeus about ⅓ to less than ½ diameter of AME. Chelicerae of male unmodified, 4–5 retromargin teeth closely spaced, distal tooth subequal to subdistal tooth except in *H. immanis*. Leg I, when outstretched alongside leg II, reaches from midway along metatarsus II to towards distal end of metatarsus. Abdomen flattened dorso-ventrally often with mottled dorsal pattern of large brownish-black patches and occasionally two or three pairs of blackish spots. Male palpal tibial apophysis equal in length to tibia, directed anteriorly, lanceolate with short curved apex. Subembolic apophysis on embolar base adjacent its junction with tegulum. Tegular apophysis absent. Short, low flange on embolar base displaced mesally by subembolic apophysis. Embolar base small with mesal ridge. Embolic sclerite modified, recessed and connecting to embolus except in *H. nigrigularis*. Embolus coiled seven to eleven times, often slightly constricted ½ turn from tip. Female epigynum with postero-lateral epigynal sclerite extending partly over fossa. Fossa somewhat truncate posteriorly. Spermathecal sacs shortish, curved.

Species included

Holconia hirsuta (L. Koch, 1875), *H. insignis* (Thorell, 1870), *H. immanis* (L. Koch, 1867), *H. nigrigularis* (Simon, 1908), *H. simoni* (Rainbow, 1911) and *H. subdola* Thorell, 1881. Undescribed species are known. Distribution is over much of the Australian mainland. Where they occur in more xeric or arid areas they are usually found on large trees or along watercourses.

Holconia insignis (Thorell)
(Figs 6–10, Table 4).

Voconia insignis Thorell, 1870: 383. Syntypes ♂ and ♀, Australia. NHRM (Thorell collection), examined.
Holconia insignis: Thorell, 1877: 485.
Isopeda insignis: Hogg, 1903, 432.

Syntype female

CL 14.3, CW 13.8. AL 22.5, AW 14.5.

Colour in alcohol: Carapace grey-brown with brown-black markings. Chelicerae brown-black. Maxillae and labium blackish. Sternum brown. Legs dark brown with white and black patches on venter of patellae and tibiae. Abdomen greyish with darker markings and an anterior median streak of pale brown. Carapace: low, flattish, slightly concave anterior of fovea; thinly covered with short setae, long bristles on lateral edges and anterior half of caput. Eyes: AME 0.7. AME: ALE: PME: PLE = 1: 1.28: 0.71: 1.00. Interspaces: AME-AME 0.57, AME-ALE 0.71, PME-PME 1.71, PME-PLE 2.14, AME-PME 1.00, ALE-PLE 1.43. MOQ, aw: pw: 1 = 2.86: 3.14: 3.40. Width of clypeus 0.40. Chelicerae: retrolateral teeth 5. Sternum L 7.8, W 6.1. Legs: (Table 4) leg II longer than leg I, ratios 4.6, 3.9 respectively. Spination: Leg I, fe d2 p3 (1 on left) r3, pa pl rl, ti d2 p2 r2 v4, me p2 r2 v4. Leg II, fe d2 p3 r3, pa pl rl, ti d2 (0 on left) p2 r2 v6, me p2 r2 v4. Leg III, fe d2 p3 r2 (1 on left), pa pl rl, ti p2 r2 v6, me p2 r2 v6. Leg IV, fe d2 p3 rl, ti pl (0 on left) v6, me p4 r2 v4. Palp, fe dl + 4 apically in transverse row, pa pl rl, ti dl p2 r2, ta p3 r2. Abdomen: flattened dorso-ventrally, broad. Epigynum: (Figs 9–10) Convex epigynal sclerite extending from lateral rim posteriorly. Fossa with humps in posterior half, somewhat truncate posteriorly. Vulva of SAMA N1988520 (Eidsvold, Q) with shortish, curved spermathecal sacs.

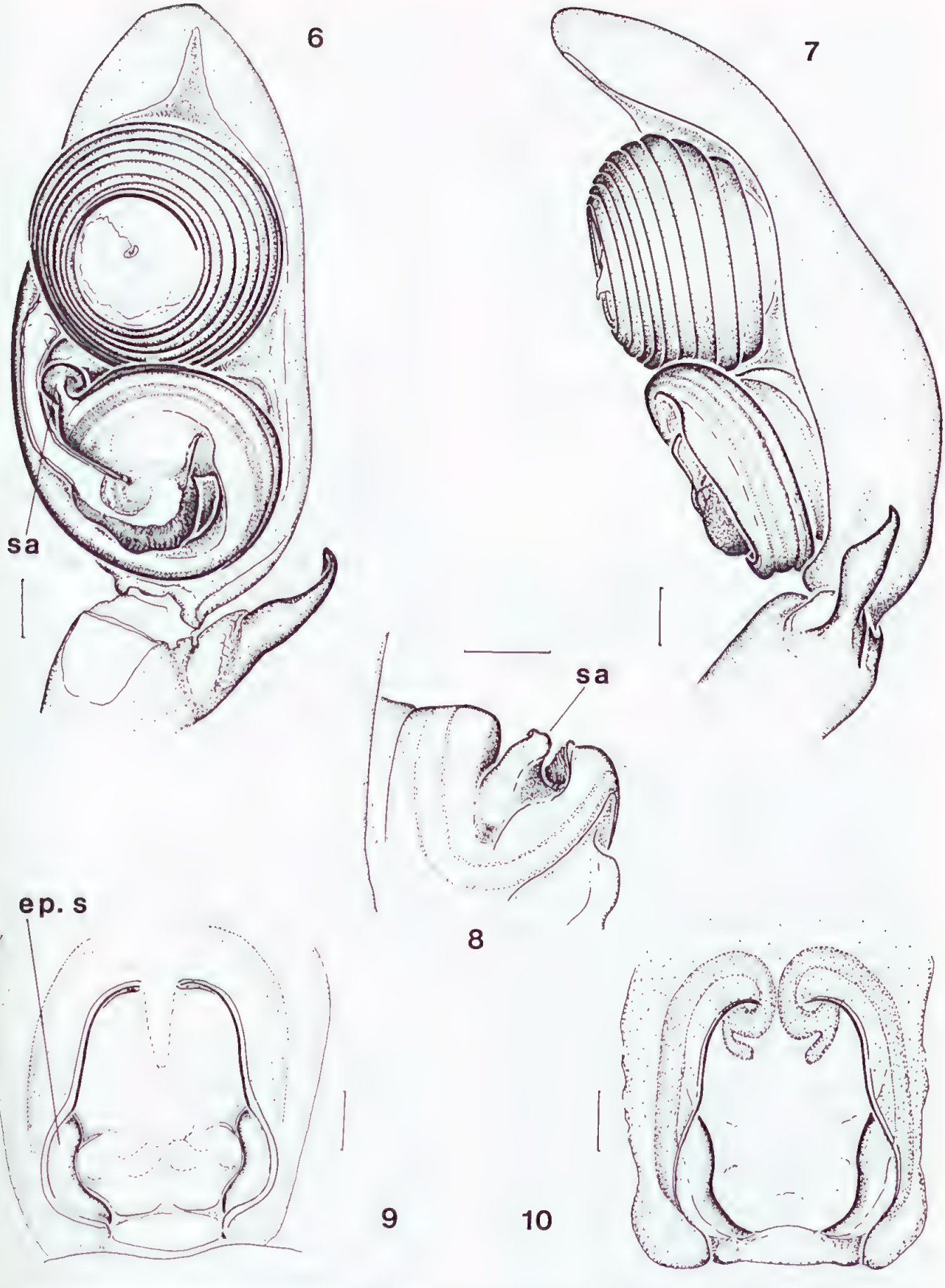
Syntype male as female except as follows:

CL 11.0, CW 10.9. AL 11.0, AW 8.2.

Eyes: AME 0.8. AME: ALE: PME: PLE = 1: 1.13: 0.63: 0.89. Interspaces: AME-AME 0.25, AME-ALE 0.25, PME-PME 1.25, PME-PLE 1.25,

TABLE 4. Leg measurements of *Holconia insignis* (Thorell), syntype female with syntype male in parentheses.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	14.5 (15.9)	7.7 (6.9)	14.4 (15.0)	16.0 (16.6)	3.6 (3.7)	56.2 (58.1)
II	17.6 (18.9)	8.3 (7.5)	18.0 (19.8)	18.6 (19.2)	3.6 (3.7)	66.1 (66.1)
III	13.0 (13.3)	6.0 (5.3)	12.0 (11.9)	11.2 (11.2)	2.9 (3.0)	45.1 (44.7)
IV	13.8 (13.4)	5.7 (4.8)	12.0 (12.1)	12.2 (12.3)	3.1 (3.4)	46.8 (45.7)
Pa	5.0 (4.4)	2.5 (2.0)	2.8 (2.2)	— —	5.0 (6.0)	15.3 (14.6)



FIGURES 6-10. *Holconia insignis* (Thorell). 6-7, right palpal tibia and tarsus of syntype male (reversed drawing): 6, ventral; 7, retrolateral. 8, subembolic apophysis, prolateral, SAMA N1988522, embolus and conductor removed. 9, epigynum of syntype female. 10, vulva of female SAMA N1988520, ventral. Scale lines 0.5 mm. sa, subembolic apophysis; ep. s, epigynal sclerite.

AME-PME 0.75, ALE-PLE 1.00. MOQ, aw: pw: 1 = 2.13: 2.44: 2.25. Width of clypeus 0.25. Sternum L 6.2, W 5.0. Legs: (Table 4) leg II longer than leg I, ratios 6.0, 5.3 respectively. Spination: Leg I, fe pl. Leg III, fe rl. Leg IV, fe p2, ti p2, rl on left, me r3. Palp, ti rl, ta 0. Palp: (Figs 6–7) Left palp abnormal, stunted. Tibial apophysis equal in length to tibia, lanceolate, laterally flattened, apex curved mesally. Embolus with 9½ coils, weakly constricted ½ turn from tip. Embolar base with short low flange mid-distal position. Subembolic apophysis at junction of tegulum and embolar base (Fig. 8 shows the prolateral aspect of the apophysis of SAMA N1988522, Pilliga Scrub, NSW).

Distribution

H. insignis occurs in south-east Queensland and eastern NSW.

Isopedella gen. nov.

Diagnosis

Male with doubly curved palpal tibial apophysis gradually tapered. Broad embolar base partly projecting over embolus retrolaterally. Female with somewhat narrow epigynum not much broader posteriorly. Spermathecal sacs absent but may be represented by short 'elbows'.

Description

Carapace convex, length equals 3–4 times height. Distance between AME-ALE about half that between AME. Distance between PME subequal to that between PME-PLE. Line drawn behind posterior eyes barely recurved to straight. Clypeus about half diameter of AME or less. Chelicerae of male unmodified, retromargin teeth closely spaced, relatively close to fang base, distal tooth subequal to subdistal tooth. Leg I subequal in length to leg II, leg I of female about 3½ times carapace length or less. Abdomen rounded with 2–3 pairs of black spots, with or without a posterior folium or with pairs of spots indistinct and whitish patches combined with a folium or with scattered brown spots. Venter usually with narrow to broad transverse band of black setae posterior to epigastric furrow. Male palpal tibia with gradually tapered, somewhat rounded retrolateral apophysis angled to venter near base before turning again to point anteriorly, curving again near apex. Embolus coiled six to nine times, gradually tapered to tip, second coil larger than third, first coil easily seen in ventral view. Embolar base broad, projecting over embolus on retrolateral side, ridge and granulations absent. Occasionally with short pro-distal flange on embolar base. Embolic sclerite absent or small and obscured by embolar base. Tegular apophysis large, ventral edge extended distally and mesally, usually with concave posterior face, most often well separated from embolar base. Epigynum relatively narrow, bell-shaped or ovate, broadest posteriorly. Area between fossa and lateral rim concave at posterior corner. Fossa may have humps, pigmentation and granulate area posteriorly. Spermathecal sacs usually absent, rarely represented as short 'elbows'.

Type species

Heteropoda pessleri Thorell, 1870.

Etymology

Isopedella refers to the generally smaller proportions of the species compared to their counterparts in *Isopeda*.

Species included

Isopedella pessleri (Thorell, 1870), *I. ardrossana (Hogg, 1903), I. cana* (Simon, 1908), *I. cerussata* (Simon, 1908), *I. conspersa* (L. Koch, 1875), *I. flavida* (L. Koch, 1875), *I. frenchi* (Hogg, 1903), *I. inola* (Strand, 1913), *I. leai* (Hogg, 1903), *I. maculigastra* (Strand, 1907), *I. meraukensis* (Chrysanthus, 1965), *I. tepperi* (Hogg, 1903), *I. tietzi* (Hogg, 1903), *I. saundersi* (Hogg, 1903) and *I. terangana* (Strand, 1911). Several unnamed species are known and many synonymies are likely. The genus is widespread over the Australian mainland and parts of New Guinea. Most species frequent areas of low trees or mallee scrub.

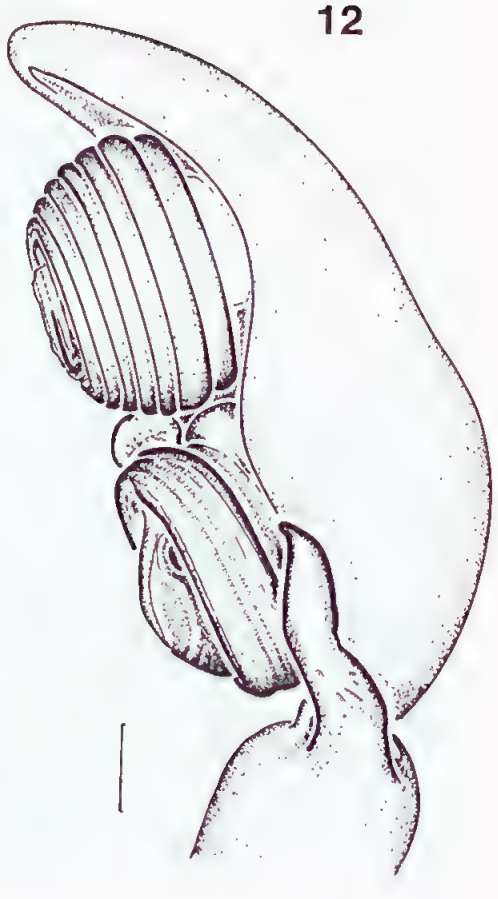
Isopedella pessleri (Thorell)
(Figs 11–15, Table 5)

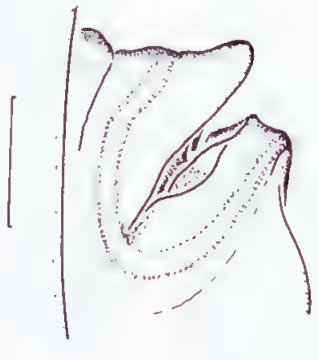
Heteropoda pessleri Thorell, 1870: 387. Holotype ♀, Australia, NHRM 1209 (Thorell Collection), examined.
Isopeda pessleri: L. Koch, 1875: 679.

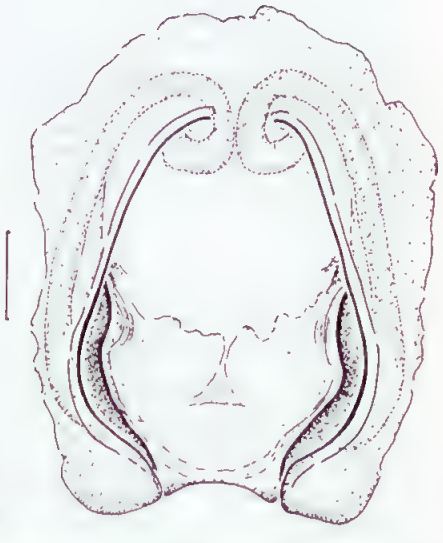
Holotype female

CL 9.0, CW 8.8. AL 9.8, AW 7.8.

Colour in alcohol: Carapace and appendages red-brown. Sternum with thick covering of long black setae. Coxae with long black setae on basal half. Abdomen grey-brown with two pairs of black spots. Venter yellow-brown with narrow transverse band of black setae behind epigastric furrow. Carapace: moderately high, convex, covered with short setae, whitish-grey in ocular region. Eyes: AME = 0.6. AME: ALE: PME: PLE = 1: 1.16: 0.75: 1.00. Interspaces: AME-AME 0.50, AME-ALE 0.42, PME-PME 1.50, PME-PLE 1.66, AME-PME 0.91, ALE-PLE 1.15. MOQ, aw: pw: 1 = 2.50: 3.00: 2.50. Width of clypeus 0.50. Chelicerae: Long pointed setae around fang base. Retrolateral teeth 5, rather







FIGURES 11-15. *Isopedella pessleri* (Thorell). 11-12, right palpal tibia and tarsus of male SAMA N1989111 (reversed drawing): 11, ventral; 12, retrolateral. 13, tegular apophysis, prolateral, SAMA N1989111, embolus and conductor removed. 14, epigynum of holotype female. 15, vulva of female SAMA N1989112, ventral. Scale lines 0.5 mm.

TABLE 5. Leg measurements of *Isopedella pessleri* (Thorell), holotype female with male SAMA N1989111 in parentheses.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	8.1 (8.5)	4.5 (3.8)	7.2 (7.6)	8.0 (8.5)	2.5 (2.5)	30.3 (30.9)
II	9.0 (9.3)	4.6 (3.8)	7.9 (8.4)	8.3 (8.6)	2.5 (2.5)	32.3 (32.6)
III	7.2 (7.3)	3.6 (2.9)	5.8 (5.7)	5.7 (5.7)	2.0 (2.0)	24.3 (23.6)
IV	7.8 (—)	3.4 (—)	6.3 (—)	6.8 (—)	2.2 (—)	26.5 (—)
Pa	2.6 (2.7)	1.6 (1.2)	2.0 (1.1)	— —	3.5 (3.7)	9.7 (8.7)

closely spaced, subdistal tooth largest. Sternum L 4.9, W 4.0. Legs: (Table 5) leg II longer than leg I, ratios 3.5, 3.3 respectively. Spination: Leg I and II, fe d2 p3 r3, pa p1 r1, ti d2 p2 r2 v6, me p2 r2 v4. Leg III, same but r2 on fe. Leg IV, fe d2 p3 r1, pa p1, ti d1 p2 r1 (r2 on left leg) v6, me p4 r4 v4. Palp, fe d1 + 4 apically in transverse row, pa p1 r1 ti d1 p2, ta p2 r1. Abdomen: clumps of short black setae form paired dorsal spots. Epigynum: (Figs 14–15) Ovate, rounded anteriorly, lateral rims diverging slightly for half their length then gently arced outwards to posterior. Posterior of fossa raised, granulated and darkly pigmented. Vulva of SAMA N1989112 (Kaleen, Canberra, ACT) lacks spermathecal sacs.

Male SAMA N1989111 (Nowra, NSW), as female except as follows:

CL 6.8, CW 6.3. AL 7.0, AW 5.0.

Colour in alcohol: Carapace and legs orange-brown. Caput and chelicerae dark red. Maxillae and labium brown. Sternum red-brown with a covering of long brown-black setae. Coxae yellow-brown with few black setae, mainly on leg I. Abdomen with narrow dark brown folium along its entire length. Venter with brown spots. Eyes: AME 0.45. AME: ALE: PME: PLE = 1: 1.13: 0.76: 1.11. Interspaces: AME-AME 0.49, AME-ALE 0.22, PME-PME 1.33, PME-PLE 1.33, AME-PME 1.07. ALE-PLE 1.07. MOQ, aw: pw: 1 = 2.58: 2.89: 2.76. Clypeus width 0.67. Chelicerae with numerous short adpressed and long upright setae. Sternum L 3.4, W 3.1. Legs: (Table 5) leg II longer than leg I, ratios 4.8, 4.5 respectively. Spination: Leg II, fe r1 on right. Leg IV, not available, both missing. Palp, ti p3 r1, ta 0. Palp: (Figs 11–13) Tibial apophysis equal in length to tibia, angled ventrally just above base, turning again to original direction before curving mesally at apex. Slightly rounded in form. Embolus with 8 coils, gradually tapered to tip. Embolar base large, extending partly over embolus retrolaterally (Fig. 11). Short pro-distal flange. Tegular apophysis large, concave, extended mesally, well separated from embolar flange.

Distribution

I. pessleri is found in southern NSW and north-eastern V.

Beregama gen. nov.

Diagnosis

Male palpal tibial apophysis straight and thin or doubly curved and, at least, broadest mid-length. Tegular apophysis weakly modified. Embolar base small, often reduced on proximal side. Female with heavily sclerotised epigynum margin. Spermathecal sacs long and looping to anterior.

Description

Carapace convex, length equals 3–4 times height. Distance between AME-ALE subequal to half that between AME. Distance between PME much less than or subequal that between PME-PLE. Line drawn behind posterior eyes usually straight. PME dome-shaped. Clypeus width equal or subequal diameter of AME. Chelicerae of male occasionally modified, swollen retro-distally with distal tooth of retromargin well separated from subdistal tooth, larger and angled anteriorly. Leg I often reaches to distal end of metatarsus of leg II. Leg I of female up to 4½ times carapace length. Abdomen without dorsal pattern except in *cordata* which has a folium. Male palpal tibial apophysis length shorter than tibia, relatively straight to curved much as in *Isopedella* but then broader mid-length or throughout. Embolus coiled from nine to fifteen times in a stack equal in width to cymbium. Embolus gradually tapered to tip. Prodistal flange on embolar base, if present, short and low. Tegular apophysis swollen, weak ridge projecting ventrally, flattish beneath, often largely obscured by embolar base. Epigynum horse-shoe shaped or in *aurea*, lateral rim broadly rounded posteriorly, both with heavily sclerotised lateral rim often appearing to be continuous anteriorly. Lateral rim of *aurea* slopes towards recessed fossa. Spermathecal sacs long, looping to anterior.

Type species

Isopeda aurea L. Koch, 1875.

Etymology

The name *Beregama* is derived from the Aboriginal word beregegama, meaning lagoon shaped like a horse-shoe, and used in reference to the shape of the epigynum margin surrounding the fossa of most species.

Species included

Beregama aurea (L. Koch, 1875), *B. cordata* (L. Koch, 1875), *B. herculea* (Thorell, 1881) and *B. goliath* (Chrysanthus, 1965). Distribution is from north-eastern NSW along the east coast and Great Dividing Range of Q to New Guinea where it appears to be common. Unnamed species occur in north-east NSW to south-east Q and N.G. These species may belong to a yet undescribed genus as the males have between 2 to 3½ embolus coils. They appear to be more primitive species closely related to *Typostola* Simon, 1897 and *Zachria* L. Koch, 1875.

Beregama aurea (L. Koch)
(Figs 16–20, Table 6)

Isopeda aurea L. Koch, 1875: 696. Syntypes immature ♀ and ♂, MacKay, Queensland, ZMH, whereabouts unknown, possibly lost. Doubtful ♀ syntype from Rockhampton, Queensland, in ZMH (Mus. Godeffroy Nr 6517), in poor condition, measured and drawn by G. Pajak.
Isopeda flavibarbis L. Koch, 1875: 698. Holotype immature, Sydney, New South Wales, ZMH (Mus. Godeffroy Nr 11015), examined. **New synonymy.**
Isopeda herculeana Strand, 1913: 610. Holotype ♀, Queensland, SMF 5020, examined. **New synonymy.**
I have chosen to give the following description from the holotype *I. herculeana* as I have not personally examined the doubtful syntype from Rockhampton. Its fragile condition excludes availability for loan.

Female SMF 5020

CL 17.2, CW 17.4. AL 24.0, AW 21.0.

Colour in alcohol: Carapace red-brown with darker flecks, whitish setae in ocular region. Chelicerae dark brown, long yellowish setae. Legs light red-brown with clumps of white setae on femora, mostly ventrally, long yellowish setae. Maxillae and labium black-brown, tipped anteriorly with orange. Sternum orange-red with long yellowish setae. Coxae orangish. Abdomen yellowish with numerous concolorous long setae. Venter with faint 'V' marking. Carapace: moderately high, convex, caput slightly raised. Eyes: AME 1.00. AME: ALE: PME: PLE = 1: 1.30: 0.80: 1.00. Interspaces: AME-AME 0.50, AME-ALE 0.50, PME-PME 1.50, PME-PLE 1.80, AME-PME 0.90, ALE-PLE 1.20. MOQ, aw: pw: 1 = 2.60: 3.00: 2.90. Width of clypeus 1.00. Chelicerae with numerous long stout setae. Retrolateral teeth 4, distal tooth well spaced from larger subdistal tooth. Maxillae rounded. Sternum L 9.5, W 7.5. Legs: (Table 6) leg II longer than leg I, ratios 4.5, 4.3 respectively. Spination: Leg I, fe d2 p2 r3, pa p1 r1, ti d2 p2 r2 v6, me p2 r2 v4. Leg II, fe d2 p3 r3, pa p1 r1, ti p2 r2 v6, me p2 r2 v4. Leg III, same but fe r2. Leg IV, fe d2 p3 r1, pa p1, ti p2 r2 v6, me p4 r3 v4. Palp, fe d1 + 4 apically in transverse row, pa p1 r1, ti d1 p3 r2, ta p2 r2. Epigynum: (Figs 19–20) Lateral rim heavily sclerotised anteriorly, sloping towards recessed fossa. Posteriorly rim rounded and concave. Vulva of AM KS16683 (Inverell, NSW) with long spermathecal sacs looping to anterior.

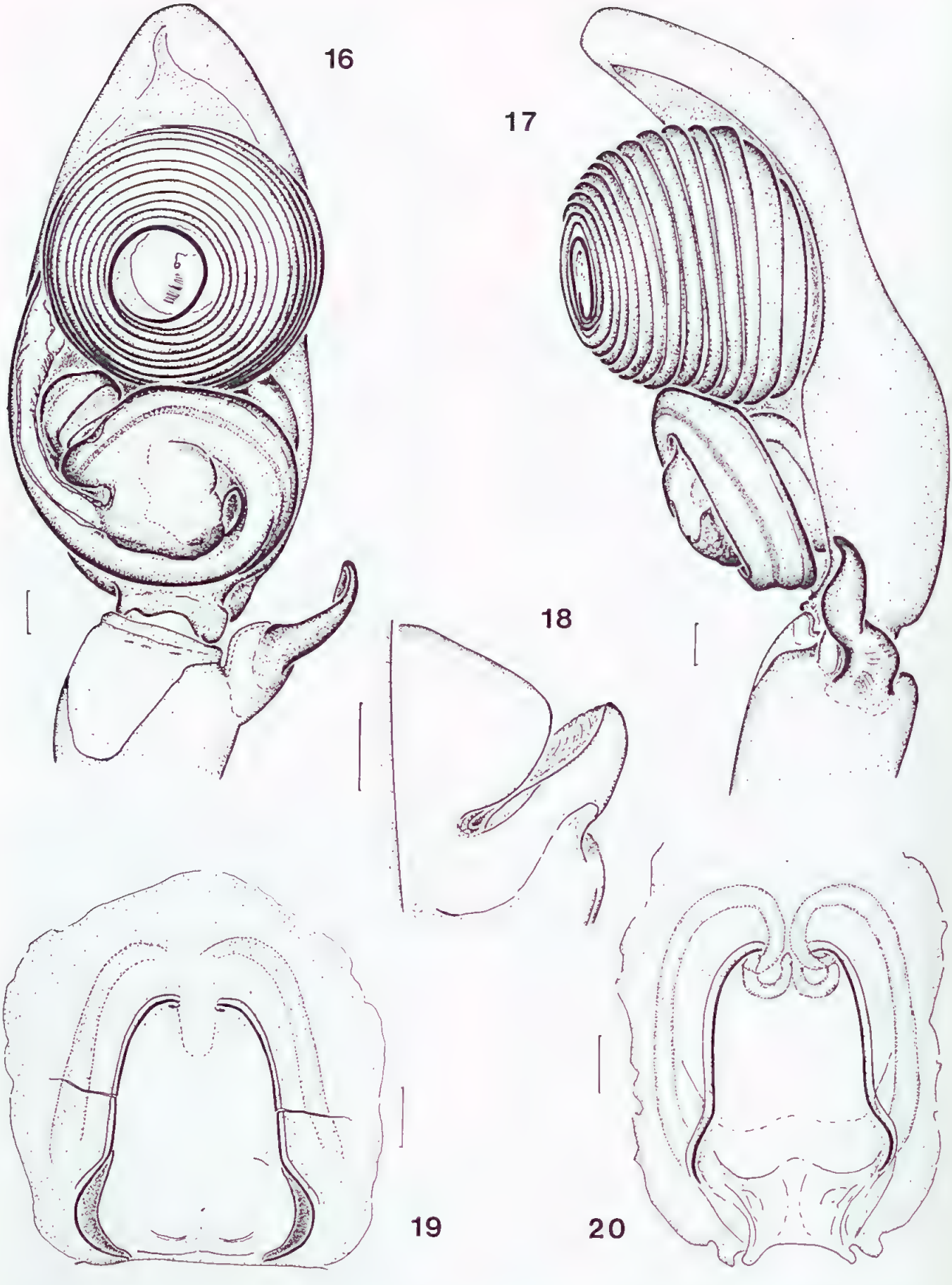
Male AM KS16662 (Emmaville, NSW) as female except as follows:

CL 14.5, CW 13.5. AL 13.8, AW 10.2.

Colour in alcohol: Carapace reddish, caput dark red, both with blackish reticulations. Chelicerae blackish-brown. Maxillae and labium dark brown. Eyes: AME 0.88. AME: ALE: PME: PLE = 1: 1.14: 0.73: 1.14. Interspaces: AME-AME 0.43, AME-ALE 0.34, PME-PME 1.20, PME-PLE 1.59, AME-PME 0.95, ALE-PLE 0.95. MOQ, aw: pw: 1 = 2.30: 2.64: 2.73. Width of clypeus 0.73. Sternum L 7.0, W 6.2. Legs: (Table 6) leg II longer than leg I, ratios 4.7, 4.2 respectively. Spination: Leg II, ti d1. Leg IV, ti 0 (1 on left). Palp, pa r2, ti r1, ta 0. Palp: (Figs 16–18)

TABLE 6. Leg measurements of *Beregama aurea* (L. Koch), holotype female *Isopeda herculeana* with male AM KS16662 in parentheses

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	20.0 (16.3)	10.0 (7.7)	19.0 (16.2)	21.0 (16.8)	5.0 (4.2)	75.0 (61.2)
II	22.0 (18.3)	10.5 (7.9)	21.5 (18.9)	23.0 (18.5)	6.5 (4.2)	77.5 (67.8)
III	15.5 (12.6)	7.5 (5.7)	14.0 (11.5)	12.5 (10.3)	4.0 (3.1)	53.5 (43.2)
IV	17.0 (13.8)	7.0 (5.4)	14.7 (12.5)	15.7 (12.6)	4.2 (3.2)	63.6 (47.5)
Pa	6.6 (5.2)	3.8 (2.5)	4.6 (2.5)	— —	7.4 (7.1)	22.4 (17.3)



FIGURES 16–20. *Beregama aurea* (L. Koch). 16–17, left palpal tibia and tarsus of male AM KS16662: 16, ventral; 17, retrolateral. 18, tegular apophysis, prolateral, distal part of conductor not drawn. 19, epigynum of holotype female *Isopeda herculeana* Strand, SMF 5020. 20, vulva of female AM KS16683, ventral. Scale lines 0.5 mm.

Tibial apophysis length shorter than tibia, angled above base to venter then curving back towards the anterior, broad mid-length. Embolus with 15 coils, last coil gradually tapered to tip. Embolar base small with short, low flange prodistally. Tegular apophysis a rounded protrusion barely distinct from tegulum, with weak ridge at apex.

Distribution

B. aurea occurs in eastern Q and north-eastern NSW.

Misplaced Species

Isopeda gloriosa Rainbow, 1917 is transferred to *Delena gloriosa* (Rainbow), **new combination.**

Isopeda immigrans Strand, 1913 is transferred to *Polybetes pythagoricus* Holmberg, 1874, **new synonymy.** The type locality of *I. immigrans*, 'Australia', is considered in error. Although recorded as arriving in England 'On cowhide from Australia', it probably entered the ship elsewhere.

Isopeda deianira Thorell, 1881 does not belong to any of the above genera. The vulva of dissected material and the embolus of males seen, lack spirals. A female of this species from New Guinea was described and figured by Chrysanthus (1965) as *Olios fimbriatus*. The male, as yet undescribed, has a large palpal tibia apophysis with large ventrally directed basal swellings and a curved, triangular embolic process which rests on a spoon shaped conductor. The tegulum has a prolateral flange.

Nomina Dubia

Voconia dolosa L. Koch, 1875: 648. Syntypes, two dry specimens from Australia, presumed lost (pers. comm. Dr F. Renner, SMNS).

Isopeda pococki Hogg, 1903: 440. The dry syntypes, male and female, from Australia without exact locality, are not in BMNH (pers. comm. P. Hillyard) and are probably lost. Although Hogg gives an adequate description this cannot be matched with known Australian species. The sternum colour excludes it from *Beregama aurea* with which it comes closest.

Isopeda robusta L. Koch, 1875. From Australia without exact locality, this species was described from a dry specimen which has most likely since been reduced to dust by dermestid beetles (pers. comm. Dr J. Gruber, NHMW). No further material recognisable from the original description has come to hand thus making this species very doubtful.

Isopeda vastata Strand, 1907. The female holotype without locality, has not been located, nor is its depository institution known. It is also not recognisable from the original description.

Acknowledgements

I wish to thank the following, who made available type and other specimens or gave assistance to make possible this paper. Dr M. Grasshoff, SMF; Dr M. Gray and C. Horseman, AM; Dr J. Gruber, NHMW; Mr P. Hillyard, BM(NH); Dr T. Kronested, NHRM; Dr B.Y. Main, BYM, Zoology Department, University of Western Australia; Dr G. Rack, ZMH; Dr R. Raven, QM; Dr F. Renner, SMNS; and Mr G. Pajak who obtained the data from the syntype female of *Isopeda aurea* whilst touring Germany. Special thanks go to Mr L.N. Nicolson and Dr D.C. Lee who gave helpful comments on the manuscript. I also thank the Australian Biological Resources Study for support.

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ORIENTAL AND AUSTRALIAN SPECIES OF THE GENUS *PROSTEMMA* LAPORTE (HETEROPTERA: NABIDAE)

I.M. KERZHNER & N.G. STROMMER

KERZHNER, I.M. & STROMMER, N.G. 1990. Oriental and Australian species of the genus *Prostemma* Laporte (Heteroptera: Nabidae). *Rec. S. Aust. Mus.* 24(1): 27-34.

Two new species, *P. walkeri* (Sri Lanka, south-west India) and *P. australicum* (Australia), and a new subspecies *P. fasciatum sulawesiense* (Sulawesi I.) are established. A key to species and revised data on distribution are given. Lectotypes of *P. carduelis* Dohrn, of its junior synonym *P. placens* Walker, and of *P. fasciatum* (Stål) are designated.

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Manuscript received 13 June 1989.

The genus *Prostemma* Laporte, 1832 is widely distributed in the Old World. The last revision of the genus was published by Reuter & Poppius (1909). A review of palearctic species is given by Kerzhner (1981), a review of Afrotropical species by the same author is in press.

The following abbreviations are used for institutions in which the material is preserved (curators who lent material are in parentheses): AM - Australian Museum, Sydney (Dr C.N. Smithers); AMNH - American Museum of Natural History, New York (the late Prof. P. Wygodzinsky); ANIC - Australian National Insect Collection, CSIRO, Canberra (Dr J.A.L. Watson); AUW - Agricultural University, Wageningen (the late Dr R.H. Cobben); BMNH — British Museum (Natural History), London (Dr W.R. Dolling); CU - Connecticut University, Storrs, Conn. (Prof. J.A. Slater); EQU - Entomology Department, Queensland University, St Lucia (the late Dr T.E. Woodward); IB - Institut Royal de l'Histoire Naturelle de Belgique, Bruxelles (Dr A. Capart); NMP - Narodni Museum, Prague (Dr L. Hoberlandt); NRS - Naturhistoriska Riksmuseet, Stockholm (Dr P. Lindskog); QM - Queensland Museum, Brisbane (Dr G.B. Monteith); SAMA - South Australian Museum, Adelaide (Dr G.F. Gross); USNM - U.S. National Museum of Natural History, Washington, D.C. (Dr Th. J. Henry); VPG -V.P. Gapud's collection, College, Laguna, Philippines; ZIL - Zoological Institute, Academy of Sciences of the USSR, Leningrad; ZMB - Zoologisches Museum der Humboldt-Universität, Berlin, GDR (Dr U. Göllner-Scheiding); ZMH - Zoological Museum, University of Helsinki (Dr A. Jansson).

The sign '!' is used for specimens examined.

All measurements are in mm.

Key to the Oriental and Australian Species of *Prostemma*

1 — Hind lobe of pronotum, scutellum and clavus (except sometimes a spot at base of outer margin) black 2
— Hind lobe of pronotum, scutellum and clavus (except its extreme apex) red 3

2(1) — Corium black with 2 yellowish white spots: at base and near the middle; the last spot is connected with the inner margin of corium by a narrow stripe. Membrane black with a spot in inner corner and apical 1/5 white. Hemelytra covering at least 4/5 of abdomen length. Length 5.6-6.7 ..... *P. flavomaculatum* Lethierry
— Corium yellow with two small black spots: near the middle of outer margin and at apex. Membrane black with a white spot in outer corner. Hemelytra reaching about half of abdomen length only. Length 6.5 ..... *P. siamense* Noualhier

3(1) — Underside of meso- and metathorax black or dark brown (sometimes mesothorax reddish in the middle). Inner corner of membrane with a white spot. Base of corium whitish or yellowish white, with a brownish vein. Length 7.8-9.8 ..... *P. carduelis* Dohrn
— Underside of meso- and metathorax red or yellow red. Inner corner of membrane without white spot. Base of corium red, with a vein of the same colour. Length as a rule less than 7.5 4

4(3) — White spot at outer corner of membrane and apex of corium triangular, part lying on corium forms about 1/10 of its length (measured at outer margin of hemelytron). White spot at apex of membrane with fore margin deeply invaginated, hind margin touching the apex of membrane, lateral corners not rounded and the outer of them connecting by a narrow whitish stripe with white spot at outer corner of membrane. Mid and hind femora brown for a least half their length. Length 6.5-7.5, width

2.0–2.4 ..... *P. australicum* sp.n.

— White spot at outer corner of membrane and apex of corium more or less quadrangular[1], the part lying on corium forms about ¼ to ½ of its length[2]. White spot on apex of membrane as a rule with fore margin straight or feebly invaginated, hind margin usually separated from apex of membrane by a more or less distinct greyish stripe, lateral corners usually rounded, never connecting with white spot at outer corner of membrane. Mid and hind femora brown less than one half, usually no more than one-third of their length 5

5(4) — White stripe of corium with subparallel fore and hind margins. White spot on apex of membrane about twice as wide as long. White spot on outer corner of membrane usually lies on corium by half its length. Length 6.5–7.6, width 2.0–2.5. ..... *P. fasciatum* (Stål), 6

— White stripe of corium distinctly widened at the middle, stripes of opposite hemelytra widely separated. White spot on apex of membrane no more than 1.5 times as wide as long. White spot on outer corner of membrane lies on corium by a third or fouth of its length. Red colour at base of hemelytra not changing before the black stripe. Length 6.1–6.8, width 1.75–1.95 ..... *P. walkeri* sp.n.

6(5) — White stripe of corium more or less subequal in width to black stripes behind and before it, often white stripes of opposite hemelytra are connected by a white spot at base of membrane. Front margin of anterior black stripe of corium straight or wavy. Red colour at base of hemelytra usually gradually turning into yellow or white before the black stripe ..... *P. f. fasciatum* (Stål)

— White stripe of corium much narrower, two to three times narrower than black stripes behind and especially before it, white stripes of opposite hemelytra not connected. Front margin of anterior black stripe of corium angulate. Red colour at base of hemelytra practically not changing before the black stripe ..... *P. f. sulawesiense* ssp.n.

[1]The form of the spot should be examined carefully. Its inner margin is often masked by black margin of the opposite membrane lying over or under the spot, therefore it may look at first glance triangular, as in the figure of *P. fasciatum* in Reuter & Poppius (1909).

[2]It is sometimes difficult to determine the border between membrane and apex of corium. The apex of corium can be distinguished by presence of hairs; besides, it is thicker than the membrane and mostly somewhat yellowish.

Prostemma flavomaculatum Lethierry, 1883
(Figs 2a, 3)

Prostemma flavomaculatum Lethierry, 1883; 649; Distant, 1904: 393.

Nabis flavomaculatus: Reuter & Poppius, 1909: 10, 17; Bergroth, 1915: 178.

Syntype(s)

Male(s) (according to Reuter & Poppius, 1909), BURMA, Minhla, leg. Comotto, stated to be in Museo Civico di Storia Naturale in Genova, not examined.

Distribution and material examined

INDIA: Bombay! (Reuter & Poppius, 1909; Bergroth, 1915; ZMH), Chick Ballapur! (BMNH), W. Almora, Kumaon, U.P. (BMNH, Dolling *in litt.*), Padang and Gopaldhara near Darjeeling! (BMNH). NEPAL: between Kathmandu and Everest (Prof. R. Remane *in litt.*). BURMA: Minhla (Lethierry, 1883), Carin, Asciuti Ghecu (BMNH, Dolling *in litt.*). We examined 14 imagos and 1 larva.

Note. The species is very closely related to the Afrotropical *P. concinnum* Walker (*eva* Kirkaldy), which is in the main larger (length 6.4–8.0), with relatively broader pronotum (proportion width to length of pronotum in *P. flavomaculatum* 1.10–1.16, in *P. concinnum* 1.18–1.23) and usually with more distinct brown rings on the femora, while the paramere in *P. concinnum* is longer, with more broadly rounded outer corner and some other differences.

Prostemma siamense Noualhier, 1896

Prostemma siamense Noualhier, 1896: 253; Noualhier & Martin, 1904: 176, pl. 10, fig. 2; Distant, 1919: 285.
Nabis siamensis: Reuter & Poppius, 1909: 10, 15.

Syntype

Female, now without head, apparently the only specimen used for description, CAMPUCHEA (Siam), Battambang (according to Reuter & Poppius, 1909), leg. A. Pavie, in Muséum National d'Histoire Naturelle, Paris (Dr J. Pericart, *in litt.*), not examined by us.

The species is known from the type only. It was examined and redescribed by Reuter & Poppius (1909).

Prostemma carduelis Dohrn, 1858
(Figs 1a, 2b, 3)

Prostemma carduelis Dohrn, 1858: 229, pl. 1, fig. 8; Distant, 1903: 253; Distant, 1904: 392, fig. 249 (part.).

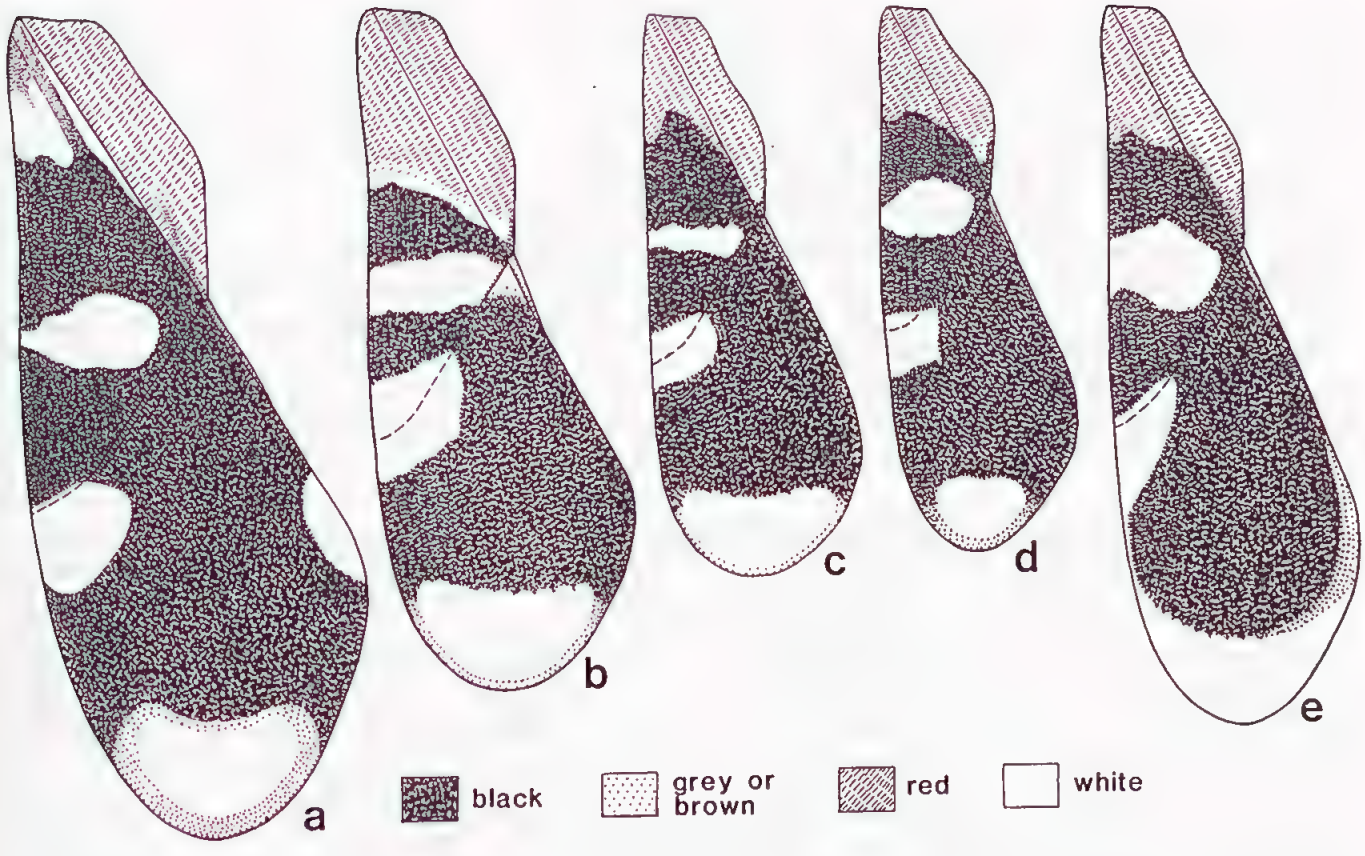

FIGURE 1. *Prostemma*, left hemelytron: a – *P. carduelis* Dohrn, b – *P. fasciatum fasciatum* (Stål), c – *P. fasciatum sulawesiense* subsp.n., d – *P. walkeri* sp.n., e – *P. australicum* sp.n.

Nabis (Poecilta) carduelis: Stål, 1873: 108.
Prostemma placens Walker, 1873: 137 (syn. by Distant, 1903).
Nabis carduelis: Reuter & Poppius, 1909: 11, 18 (part.).
Nabis carduelis var. *placens*: Reuter & Poppius, 1909: 19.

Types

Lectotypes: of *carduelis*, male, hereby designated, labelled '3259', 'Type', '*carduelis* Dohrn, Ceylon, [leg.] Nietn[er]', '*Nabis carduelis* Dohrn. F. Schumacher rev.', in ZMB. Syntypes from Colombo in Dohrn's collection (now in Warsaw), probably lost.

Of *placens*, female, hereby designated, labelled 'Type', 'Saunders 65.13', 'Ind.', '27. *Prostemma placens*', in BMNH. Paralectotype: male (not female as stated in the original description) labelled 'E. Ind.' (hand-written circular label), '*Prostemma placens*, Walker's Catal.', in BMNH, examined.

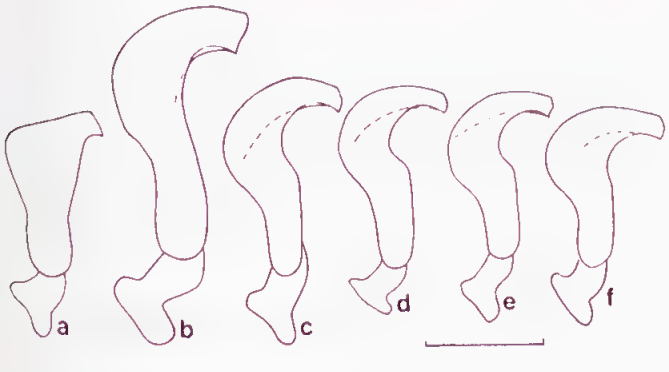

FIGURE 2. *Prostemma*, left paramere: a – *P. flavomaculatum* Lethierry, Chick Ballapur, b – *P. carduelis* Dohrn, Coimbatore, c – *P. fasciatum fasciatum* (Stål), Bhamo, d – *P. fasciatum sulawesiense* subsp.n., holotype, e – *P. walkeri* sp.n., holotype, f – *P. australicum* sp.n., Townsville.

Distribution and material examined

SRI LANKA: Colombo (Dohrn, 1858), also specimens labelled 'Ceylon' and collected by Nietner! (ZMB), by Green! (BMNH) and by unknown person! (NRS). INDIA: Coimbatore! (AMNH, CU, USNM, ZIL), Nilgiri Hills! (CU), Chick Ballapur! (BMNH), Secunderabad! (BMNH), Poona! (BMNH), Mile 4 Wiramgan to Kharagoda, Bombay! (BMNH), Mandar! (IB), Janjgir, Bilaspur! (BMNH), Pusa! (BMNH), Purnea Distr.! (BMNH), Balasore (Reuter & Poppius, 1909), also specimens without exact localities! (BMNH). NEPAL: Terai! (BMNH), Indrawati Khola, Saretar! (NMP). We examined 23 specimens.

Notes. The species is closely related to the Afrotropical *P. falkensteinii* Stein, from which it differs in the less dense punctuation of the hind lobe of pronotum and smaller paramere. Distant's (1904)

record from Burma, judging from specimens in BMNH and ZIL collected by L. Fea, refers to *P. fasciatum*. Reuter & Poppius (1909), judging from their data on the colour of thorax ('meso- et metapleuris nigris vel rufo-testaceis') and the length of the 'typical form' (6 mm), apparently confused under *P. carduelis* 3 species: their specimens of 'var. *placens*' from India belong to *P. carduelis*, whereas specimens identified as the typical form of *P. carduelis* belong in fact to *P. fasciatum* (Burma, Vietnam) and *P. walkeri* (Sri Lanka). Philippine specimens recorded as *P. carduelis* by Stål (1871) were later described by him as a new species *P. fasciatum*.

Prostemma fasciatum fasciatum (Stål, 1873)
(Figs 1b, 2c, 4)

Nabis (Poecilta) fasciata Stål, 1873: 108.
Nabis fasciatus: Kirkaldy, 1901: 220; Reuter & Poppius, 1909: 11, 19, fig 3; Poppius, 1914: 135; Gross, 1963: 390.
Prostemma fasciatum: Takara, 1957: 52; Hasegawa, 1962: 20, fig. 21; Miyamoto & Hidaka, 1963: 80; Miyamoto, 1964: 275; Kerzhner, 1970: 357; Hsiao & Ren, 1981: 544 (not pl. 82, fig. 804 representing a species of *Rhamphocoris*!).
Metastemma carduelis (misidentification): Stål, 1871: 675.

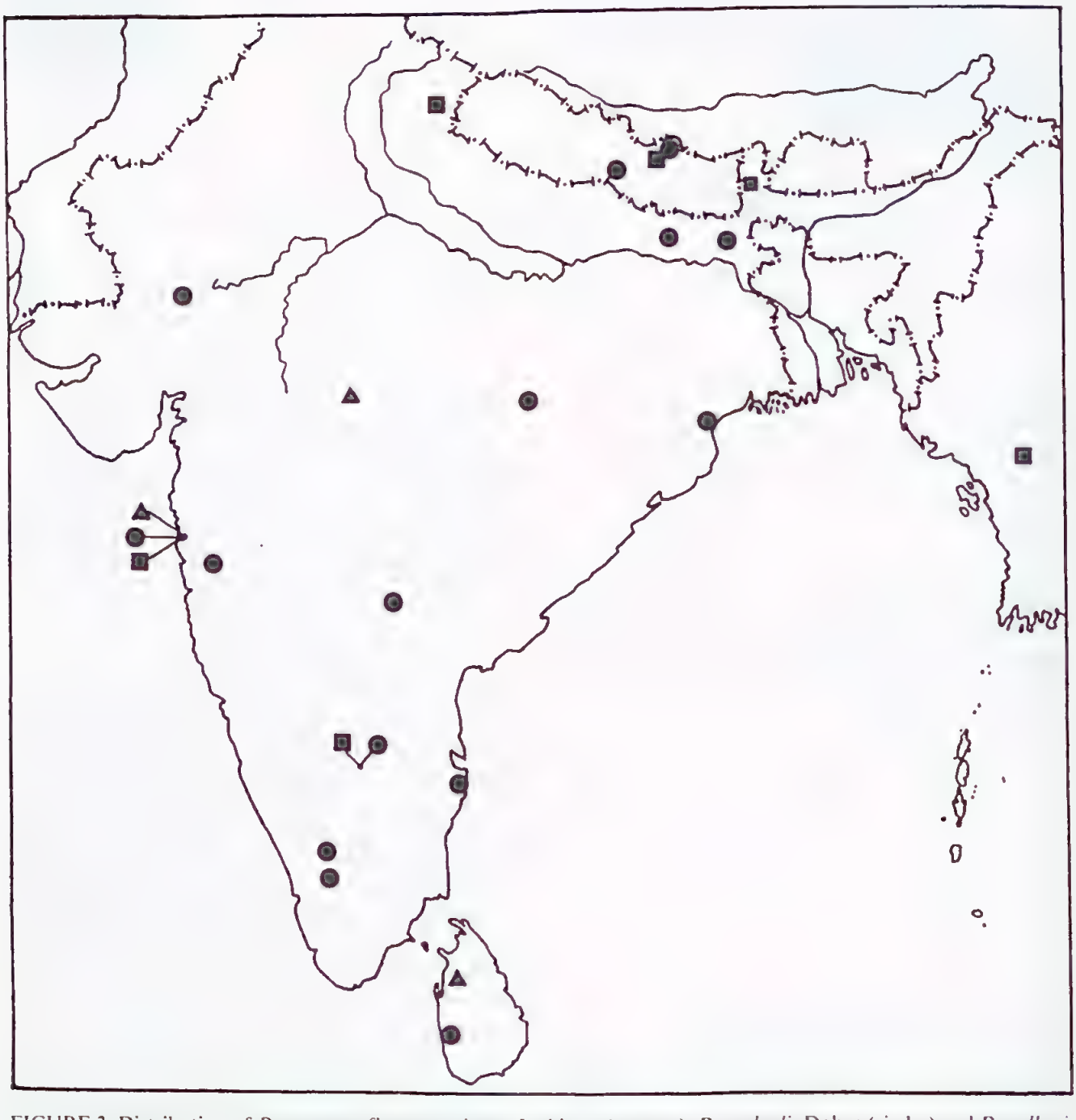

FIGURE 3. Distribution of *Prostemma flavomaculatum* Lethierry (squares), *P. carduelis* Dohrn (circles) and *P. walkeri* sp.n. (triangles).

Prostemma carduelis (misidentification): Distant, 1904: 392 (part.).
Nabis carduelis (misidentification): Reuter & Poppius, 1909: 18 (part.).

Type

Lectotype: female (not male as stated in the original description!), hereby designated, labelled *fasciata* (Stål' (apparently in (Stål's handwriting), NRS. The species was described from the Philippines.

Distribution and material examined

INDIA: Purnea Distr.! (BMNH). BURMA: Bhamo! (Distant, 1904, as *carduelis*; BMNH, ZIL). Pegu, Palon (Kirkaldy, 1901; Distant, 1904, as *carduelis*; Reuter & Poppius, 1909, as *carduelis*), Tikekee (Reuter & Poppius, 1909, as *carduelis*). THAILAND: Bangkok! (BMNH), Ratburi! (USNM), Chieng Mai (Hasegawa, 1962). LAOS: Vientiane! (BMNH, ZIL). CAMPUCHEA: Kampong Cham and Siem Reap (Hasegawa, 1962). VIETNAM: Chiem Hoa (Reuter & Poppius, 1909, as *cardeulis*), Hanoi! (ZIL), Tam Dao! (ZIL), Dong Hoi! (ZIL), Prov. Gia Lai- Công Tum! (ZIL). S. CHINA: *Guangxi:* Yanshan (Hsiao & Ren, 1981); *Guangdong*: Guangzhou (Hsiao & Ren, 1981), Linhsien (Linchow) (=Lianxian)! (BMNH); *Fujian*: Gu Shan nr Fuzhou! (ZIL). TAIWAN (Hasegawa, 1962; Miyamoto, 1964; Hsiao & Ren, 1981). JAPAN: Amami-Oshima, Okinawa and Iriomote Islands (Takara, 1957; Miyamoto & Hidaka, 1963; Miyamoto, 1964). PHILIPPINES: no exact locality, lectotype! (Stål, 1873; NRS); *Luzon*: Alabang, Rizal Prov.! (USNM), Mt Makiling! (VPG); Mindanao: Davao! (ZMH), Momungan! (BMNH). MALAYSIA: *Selangor*: Kuala Lumpur! (BMNH); *Sabah*: 'NO Borneo' (Poppius, 1914), Mt Kinabalu, Tenom Kinangau! (BMNH), Bellotan nr Sandakan (BMNH); *Sarawak*: Ban! (BMNH), Kuching (BMNH). INDONESIA: *Sumatra* (Reuter & Poppius, 1909): Tebingtinggi! (Poppius, 1914; ZMH), Medan! (NRS), Tjinta Radja! (NRS), Tanjungmorawa! (AUW, ZIL), Paggar Barban! (AUW), Labuan Bilik! (ZMH), Fort de Kock (=Bukittingi)! (BMNH); *Java*: Chandoc (Reuter & Poppius, 1909), Sukabumi (Poppius, 1914), nr Banyumas! (BMNH), Banyuwangi! (ZIL). We examined 43 specimens. Many of them were collected at light.

Prostemma fasciatum sulawesiense subsp.n.
(Figs 1c, 2d, 4)

Diagnosis

Differs from the nominotypical subspecies by the colour of the hemelytra, as indicated in the key. The paramere is slightly smaller, but does not differ in form.

Types

Holotype: male (badly damaged, without head and some legs), INDONESIA, south of Sulawesi Island, Macassar (now Ujung Pandang), leg. W. Doherty, 1903–31 (BMNH).

Paratype: female, INDONESIA, south of Sulawesi Island, 'Lompoh Batang' (Lompobattang Mt), 200 m leg. H. Lucht (AUW).

Prostemma walkeri sp.n.
(Figs 1d, 2e, 3)

'Prostemma carduelis var.?': Walker, 1873: 137.

Description

Body covered by long black hairs. Head, pronotum, a narrow stripe at outer margin of corium, legs, underside of pro- and mesothorax and of abdomen shining, the remaining parts dull. Hind lobe of pronotum with few scattered punctures. Hemelytra reaching or slightly surpassing the apex of abdomen. Fore femora strongly thickened, but without angular projection near the middle.

Head and rostrum black or blackish brown, segment IV of rostrum yellow. Antennae yellow to brown. Fore lobe of pronotum black, hind lobe red. Scutellum red to yellowish red. Clavus red, its extreme apex with black margins and usually with a very small yellowish spot. Base of corium (about a third of its length) red, remaining part black, with a transverse spot in the middle and apex white. The white spot is distinctly narrowed to outer margin of corium, its inner margin is rounded. Membrane black, outer corner with a sub-quadrate white spot partly (by ¼ to ⅓ of its length) lying at apex of corium. Inner corner of membrane without white spot. Apex of membrane with a white spot separated from hind margin of membrane by a greyish stripe. Fore margin of this white spot nearly straight, outer corners broadly rounded, width of spot about 1.5 times its length. Hypocostal lamina red, blackish at extreme apex. Underside of body black or dark brown, except hind part of propleurae, meso- and metathorax red or yellowish red. Fore coxae dark brown, mid and hind coxae light brown. Trochanters pale yellow. Fore femora dark brown, apical fourth pale yellow. Mid and hind femora yellow with the middle third brown. Tibiae and tarsi yellow to brown.

Paramere as in *P. fasciatum*, but smaller.

Length ♂ 6.1–6.8, ♀ 6.5, width ♂ 1.75–1.95, ♀ 1.9.

Measurements: Head length (except neck and base of rostrum) ♂ 0.71–0.79, ♀ 0.71, width ♂ 0.73–0.83, ♀ 0.79, interocular distance ♂ 0.31–0.34, ♀ 0.33, antennal segments length 0.37 (0.11 + 0.79) – (0.14 + 0.93), 0.81, 0.79, pronotum length ♂

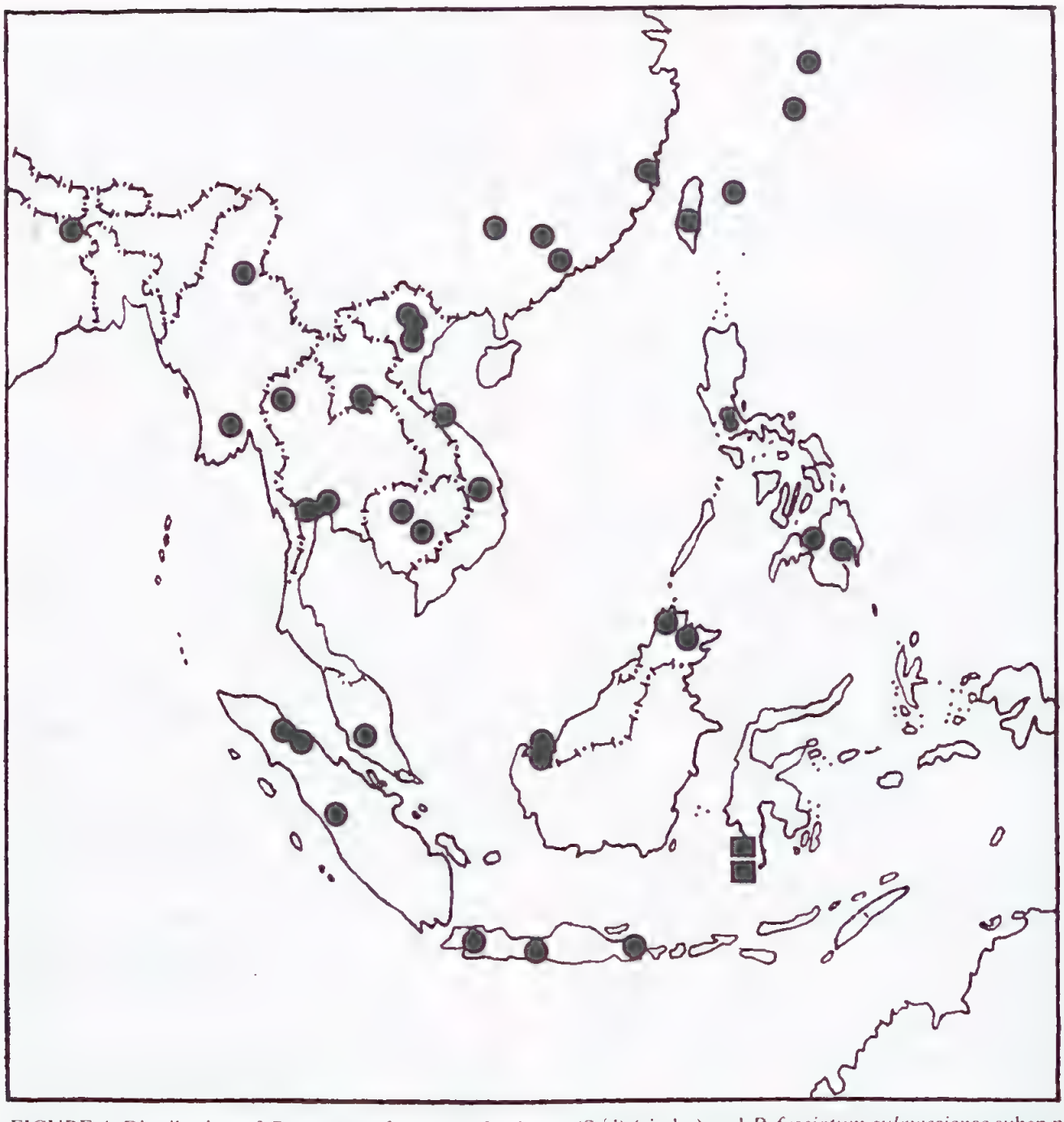

FIGURE 4. Distribution of *Prostemma fasciatum fasciatum* (Stål) (circles) and *P. fasciatum sulawesiense* subsp.n. (squares).

1.36–1.54, ♀ 1.41, width ♂ 1.79–1.96, ♀ 1.80, hind tibia length 1.80–2.15.

Types

Holotype: male, SRI LANKA, Nat. Park Wilpattu, Talawila, 13 km W. of Maradanmaduwa, 7–9 Oct. 1982, V. Zaitzev (ZIL).

Paratypes: INDIA: 1♂, Hoshangabad, at light, 14–19 Oct. 1911, T.B.F. (BMNH); 1♀ labelled 'E.Ind.' (on circular label), with explanatory label of Dr W.R. Dolling 'Wooley/Hewitson, probably Bombay, Walker's *"carduelis* var.?", (BMNH).

Notes. The new species is closely related to *P. fasciatum*, but differs in somewhat more slender body as well as in the form of the white markings as indicated in the key. It is named in honour of F. Walker, who published its first description.

Prostemma australicum sp.n.
(Figs 1e, 2f, 5)

Description

Body covered with long black hairs. Head, pronotum, a narrow stripe at outer margin of corium, legs, underside of pro- and mesothorax and of abdomen shining, the remaining parts dull. Hind lobe of pronotum with few scattered punctures. Hemelytra reaching or slightly surpassing apex of

abdomen. Fore femora strongly thickened, but without angular projection near middle.

Head and rostrum black or blackish brown, segment IV of rostrum yellow. Antennae yellow to brown. Fore lobe of pronotum black, hind lobe red. Scutellum red. Clavus red, its extreme apex black or with black margins. Base of corium (about a third of its length) red, remaining part black with a transverse spot near middle and extreme apex white. White spot is distinctly narrowed to outer margin of corium, its inner margin is rounded or angular. Membrane black, outer corner with a triangular white spot, occupying also extreme apical margin of corium. Inner corner of membrane without white spot, but often with a greyish white margin. Apex of membrane with a white spot not separated from hind margin of membrane by a greyish stripe. Fore margin of this white spot deeply concave, outer corners prolonged along the margins of the membrane in form of greyish or white stripes reaching the white spot at outer corner of membrane and often the inner corner of membrane. Hypocostal lamina red, blackish at extreme apex. Underside of body black or dark brown, except hind part of propleurae, meso- and metathorax red or yellow. Fore coxae dark brown, mid and hind coxae deep yellow to brownish yellow. Trochanters pale yellow. Fore femora dark brown, pale yellow apically; mid and hind femora dark brown, about ⅓ basal yellow, sometimes yellow apically on the ventral side, brown part occupies more than a half length of femur. Tibiae and tarsi brownish yellow.

Paramere relatively broader than in *P. fasciatum* and *P. walkeri*, with less invaginated inner margin.

Length ♂ 6.5–7.1, ♀ 6.3–7.45, width ♂ 2.0–2.35, ♀ 2.0–2.4.

Measurements: Head length (except neck and base of rostrum) about 0.75–0.80, width 0.80–0.85, interocular distance 0.34–0.40, antennal segments length 0.35–0.45, (0.10 + 0.95) – (0.12 + 1.13), 1.00–1.07, 0.80–0.95, pronotum length 1.45–1.65, width 1.85–2.20.

Types

Holotype: male, AUSTRALIA, *Queensland*, Leichhardt Falls, 35 ml SE of Burketown, 24 May 1972, G.B. and S.R. Monteith (EQU).

Paratypes: AUSTRALIA: *Queensland:* 1♂, 2♀, same labels as in holotype (EQU); 1♂, Camooweal, 15 Sept. 1968, K. Armstrong (AM); 1♂, 1♀, Townsville, Jan. and Feb. 1945, B. Malkin (USNM); 1♂, 31 km NW by N of Longreach, 23°13′S, 144°04′E, 10 May 1973, M.S. Upton (ANIC); 1♀, Cunnamulla, Nov. 1941, N. Geary (AM); 1♀, Wallaville, T.L. Bancroff; *Western Australia*: 1♀, Kimberley Distr., March 1911, Mjöberg (NRS); *Northern Territory*: 1♀, Coastal Plains Research Station, C.S.I.R.O., nr Darwin, at light, 6 June 1966, E. Langfield (ANIC); 1♀, 5 km NNW of Cahills Crossing, East Alligator Riv., 12°23′S, 132°57′E, 8 June 1973, R. Kitching (ANIC); 2♀, 4 km W of Coolibah HS, 15°34′S, 130°54′E, 13 June 1968, M. Mendum (ANIC); 1♂, 1♀, Tindal, 14°31′S, 132°22′E, 1–20 Dec. 1967, light trap, W.J.M. Vestjens (ANIC); 1♀, Katherine Riv., 25 km NE of Katherine, 3 Oct. 1977, G.F. Gross and J.A. Forrest (SAMA); 7♀, Lake Woods, 15 km SW of Elliot, at light, 5 Oct. 1977, G.F. Gross (SAMA); 1♀, 22 mls S of Alice Springs, 15 Feb. 1966, J.A. Grant, BM/CSIRO Expedition (BMNH); *New South Wales*: 1♂, Bogan Riv., Jan. 1932, J. Armstrong (AM); 2♀, 'The Cubas', via Booligal, 21 Feb.–1 March 1965, A. Forbes (AM); *South Australia*: 2♀, Madigan Gulf, Lake Eyre, at light, 5 Nov. 1955, E.T. Giles (SAMA).

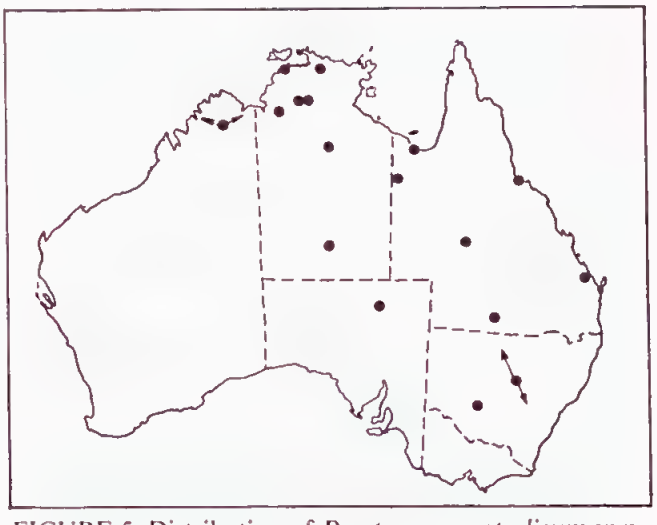

FIGURE 5. Distribution of *Prostemma australicum* sp.n.

Notes

This species represents the first record of the genus *Prostemma* from Australia, and was mentioned by Woodward & Strommer (1982), when they referred to a genus of Nabidae, not recorded from Australia. Characters differentiating *P. australicum* from the closely related oriental *P. fasciatum* and *P. walkeri* are indicated in the key.

ACKNOWLEDGEMENTS

The authors acknowledge the help of all curators listed with their institutions in the introduction, who provided material for this study.

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REVISION OF AUSTRALIAN *HYDROBIOMORPHA* BLACKBURN (COLEOPTERA: HYDROPHILIDAE)

C.H.S. WATTS

WATTS, C.H.S. 1990. Revision of Australian *Hydrobiomorpha* B. (Coleoptera: Hydrophilidae). *Rec. S. Aust. Mus.* **24**(1): 35–42.

The Australian members of the hydrophilid genus *Hydrobiomorpha* Blackburn are revised and redescribed and a key to the species is given. Five species are recognised; *H. troxi* sp. nov., *H. microspina* sp. nov., *H. helenae* Blackburn, *H. bovilli* Blackburn and *H. debbae* sp. nov. *H. tepperi* Blackburn is synonymised with *H. bovilli* Blackburn.

C.H.S. Watts, South Australian Museum, North Terrace, Adelaide, South Australia 5000.
Manuscript received 31 July 1989.

The five Australian species of *Hydrobiomorpha* Blackburn, 1888, are restricted to coastal areas of northern Australia. *H. bovilli* Blackburn and *H. helenae* Blackburn are by far the commonest, sometimes being collected in large numbers at light. The other species, all new, are widespread but infrequently collected. Nothing is known of their life history.

The genus of about 30 species, which is widely distributed in tropical Asia, Africa, Australia and South America, was revised by Mouchamps (1959) who briefly redescribed the three Australian species then recognised and figured the male genitalia of *H. helenae* and *H. tepperi* (= *H. bovilli*).

The collections from which specimens were examined are listed under the following abbreviations:

AM	Australian Museum, Sydney
ANIC	Australian National Insect Collection, Canberra
BMNH	British Museum (Natural History), London
CW	Private Collection of Author
EUQ	University of Queensland, Brisbane
NMV	Museum of Victoria, Melbourne
NTM	Northern Territory Museum and Art Gallery, Darwin
QDPIM	Queensland Department of Primary Industries, Mareeba
QM	Queensland Museum, Brisbane
SAMA	South Australian Museum, Adelaide
WAM	Western Australian Museum, Perth

SYSTEMATICS

Hydrobiomorpha Blackburn, 1888

Hydrobiomorpha Blackburn, 1888, p. 814.
Neohydrophilus d'Orchymont, 1912, p. 59, syn. after Mouchamps, 1959.
Type species: *Hydrobiomorpha bovilli* Blackburn, 1888, subsequent designation of Knisch, 1924. *Neohydrophilus deplanatus* d'Orchymont from East Africa, by original designation of d'Orchymont, 1919.

The genus belongs to the sub-family Hydrophilinae, characterised by a continuous median longitudinal keel on the underside which is prolonged into a spine between the hind coxae (Figs 1, 2). Within the Australasian members of the sub-family, *Hydrobiomorpha* is characterised by having the front of the ventral keel notched, the prosternal pillar not hooded to receive the front end of the ventral keel and with a backward pointing spine in most species (Figs 16–23), the basal portion of only the profemora rugose, five rows of serial punctures on the elytra including a sub-lateral row, and the front margin of the clypeus widely emarginate exposing an extensive membranous area except in *H. troxi*.

Males differ from females by having the claws on all legs more sharply bent than in the females and with a bulbous basal portion which is lacking in the females. Compared with females the protarsi are slightly more expanded. The maxillary palpi are simple in the female but variously expanded in males, particularly the second joint.

Key to Australian *Hydrobiomorpha*

1. — Membranous areas on frons reduced to small shallow area in centre (Fig. 9); head strongly punctured; bare area at apex of last abdominal segment large . . . *troxi* sp. nov.
   — Membranous area on frons extensive (Figs 8 and 10); punctures on head variable; bare area at apex of last abdominal segment variable, usually lacking or small 2

2. — Spine on pronotal pillar lacking (Fig. 16); aedeagus without dorsal notch (Fig. 15)..... *microspina* sp. nov.
   — Spine on pronotal pillar well developed (Fig. 22); aedeagus with deep dorsal notch (Figs 13 and 14).....3
3. — Back portion of keel less than twice width of front portion, front portion dipping virtually at right angles beyond notch..4
   — Back portion of keel more than twice the width of front portion, front portion gently dipping in front of notch..... *helenae* Blackburn
4. — Spine on pronotal pillar long (Figs. 22 and 23); central portion of membranous area at front of frons relatively wide (Fig. 8); maxillary palpi of male weakly expanded (Fig. 3); groove along front edge of pronotum usually reaching past inner edge of eye..... *bovilli* Blackburn
   — Spine on pronotal pillar short; central portion of membranous area at front of frons relatively small (Fig. 10); maxillary palpi of male strongly expanded (Fig. 7); groove along front edge of pronotum usually not reaching to middle of eye..... *debbae* sp. nov.

Hydrobiomorpha troxi sp. nov.

Description (number examined 10). (Figs 4, 9, 11, 21)

Length 15–17 mm. Broadly oval. Predominantly black; elytron with about ten thin lighter lines visible in some lights; ends of legs and appendages lighter. Head densely covered with strong, variably sized punctures, the largest about twice size of smallest; row of very large punctures along inner edge of eye; a rough semicircle of very large punctures forward from each eye; a few large punctures along rear edge of clypeus and a short row of large punctures in middle of clypeus; finely reticulate; membranous area between frons and clypeus black, reduced to small narrow area in middle half (Fig. 9). Pronotum with somewhat sparser and weaker punctures than on head; finely reticulate; two oblique lines of large punctures and a short line or patch of punctures in front of them on each side; groove along front edge reaching to about level of inner edge of eye. Elytron finely reticulate; punctures sparser and finer than on pronotum with five rows of large serial punctures all but the outer in well marked single row, those in third row sparser than in others. Sternal keel widely expanded in posterior half which is weakly grooved in midline, produced backwards into a short spine. Front portion of keel curving slowly upwards in front of notch, notch at or little below plane of rest of keel. Pronotal pillar narrow in lateral view, broad in ventral view with long setae, bulbous in front, small stout spine behind (Fig. 21). Meso- and metasterna and abdomen except keel, legs and large apical patch on last abdominal sternite, rugose-punctate. Non-rugose portion on apical sternite finely reticulate and with scattered very fine punctures. Lateral wings of mesosternum with extra portion on front edge. Front portion of gula lightly covered with moderate sized punctures of varying sizes, basal portion with a few similar punctures at each side only. Spines on apical edge of protibia enlarged, robust, both approximately same length and spatulate but outer a little larger.

Male

Protarsi slightly expanded, spine on apex of protibia larger, claws on all legs more sharply bent than in female with bulbous basal portion. Maxillary palpi with second joint expanded with shallow groove on ventral surface, apical joint much shorter than others (Fig. 4). Aedeagus as in Fig. 11.

Distribution

Known only from coastal Northern Territory.

Types

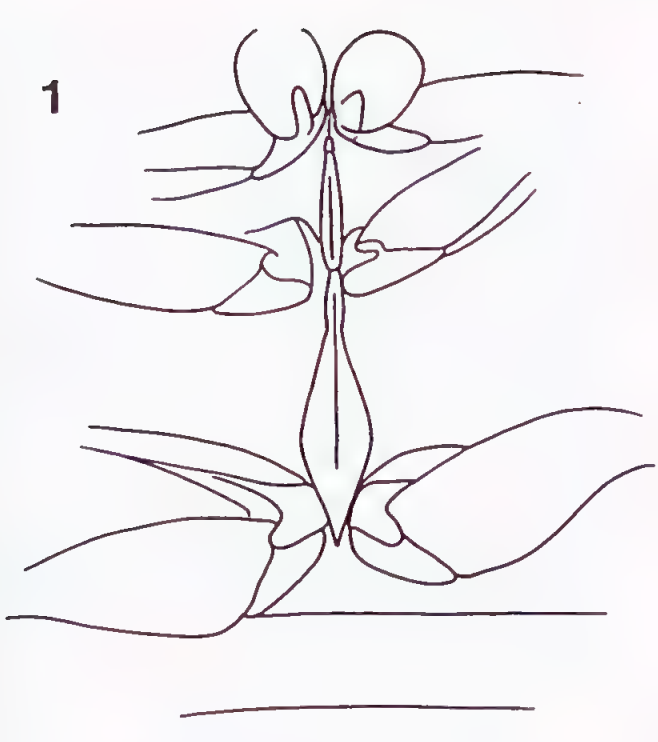
Holotype: M. 12°52′S 132°47′E, Noulangie Creek, N.T., 8 km E. of Mt Cahill, 22.v.1973, at light, E.G. Matthews, SAMA.

Paratypes: 1, same data as Holotype, ANIC; 1, Australia, N.T. Humpty Doo 6 km E. 9.ii–4.iii. 1987, R.I. Storey, QDPIM; 4, King R. N.T., 24.12.15, one with additional label, King R. N.T. Coll'd W. McLennan. 24.12.15. Pres. H.L. White 17.10v6, NMV; 1, King R. N.T., 24.12.15, CW; 1, Port Darwin N.T., SAMA; 1, N.T. Australia. Groote Eylandt 17.III.1925. G.H. Wilkins, BMNH.

Remarks

H. troxi is a distinctive species (reminding me of the trogid genus *Trox*), and is readily separated from other Australian *Hydrobiomorpha* by the lack of an extensive membranous area at the front of the frons, the strong even punctation on the frons, the large shiny area at the apex of the apical sternite, and the short apical segment of the male palpi.

FIGURES 1–10. 1, keel of *H. helenae*; 2, keel of *H. bovilli*; 3, ventral view of male maxillary palpus of *H. bovilli*; 4, ditto, *H. troxi*; 5, ditto, *H. microspina*; 6, ditto, *H. debbae*; 7, ditto, *H. helenae*; 8, frons area of head of *H. helenae*; 9, ditto *H. troxi*; 10, ditto *H. debbae*.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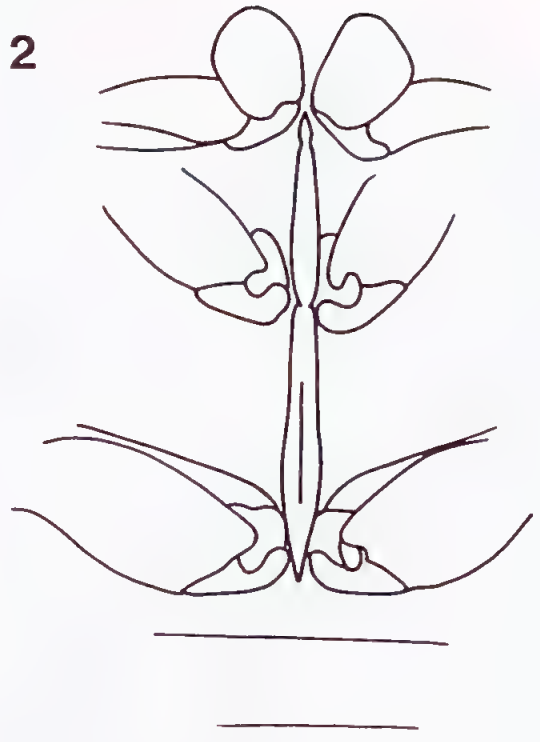
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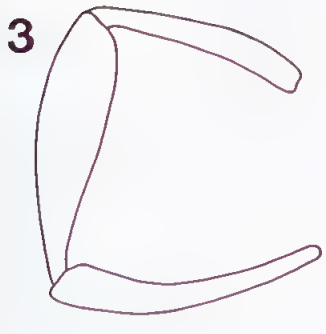
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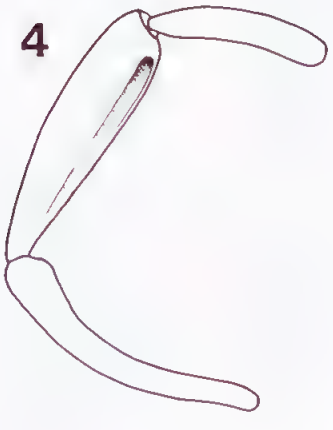
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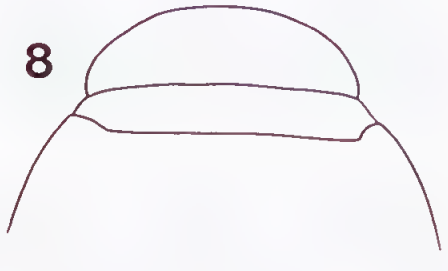
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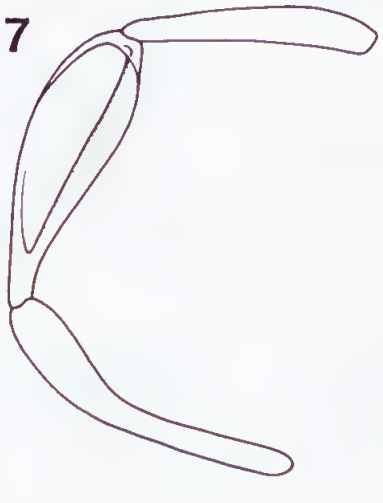
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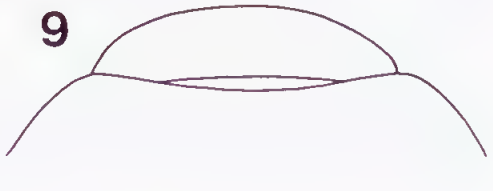
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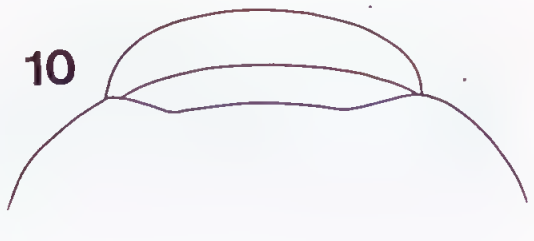
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Hydrobiomorpha microspina sp. nov.

Description (number examined 21). (Figs 5, 15, 16, 17)

Length 11–16 mm. Oval. Predominantly black; front and sides of clypeus testaceous, border of colour a little broader in midline; appendages and much of underside testaceous. Head, finely reticulate, quite densely covered in quite large (for genus) punctures; a patch of much larger punctures on inner edge of eye; a rough, broken semicircle of similar punctures forward from eye; rear margin of clypeus with several large punctures; front portion of gula covered in very strong punctures, much sparser and smaller on hind portion almost lacking in midline; membranous area between frons and clypeus broad, broadest part restricted to not much more than central half. Elytra sculptured as on pronotum, with five uneven (particularly lateral ones) rows of large serial punctures. Pronotum, with fine reticulation, covered with punctures noticeably weaker than those on head; sides with two short oblique lines of large punctures and one line parallel to edge; grooves along front edge variable in length, from virtually non-existant to nearly joining in centre. Sternal keel weakly expanded in posterior half, produced behind into a broad blunt spine. Meso- and metasternum and abdomen rugosely punctate except sternal keel and appendages. Apical abdominal sternite without, or with only a trace of, bare area at apex. Lateral wing of metasternum with narrow extra portion on front edge. Front portion of sternal keel curving upwards rapidly, notch at or a little above level of rest of keel. Pronotal pillar moderately narrow in ventral view, front edge bulbous, spine on hind edge lacking or very small (Figs 16, 17).

Male

Protarsi slightly expanded, claws on all legs more sharply bent than in female with bulbous hind portion. Maxillary and labial palps stout, particularly second segments of maxillary palpi (Fig. 5). Aedeagus as in Fig. 15.

Distribution

Restricted to wetter coastal areas of the Northern Territory and Cape York. Known only from type localities.

Types

Holotype: M. N.T. At light, 10 mi E. Daly River. 28 June 1972. B.K. Head, SAMA.

Paratypes: 2, At MV lamp. Mornington Is. Mission Qld., 15 May 1963, N.B. Tindale and P. Aitken; 1, Mornington Is. Mission Qld., 15 May 1963, P. Aitken, N. Tindale, SAMA; 3, Mataranka, N.T. 1 March 1967 M.S. Upton, ANIC, CW; 1, Daly R. Mission N.T. 19 km E. by S. of Mt Borradaile, 31.v.73, at light, E.G. Matthews, SAMA; 1, Ditto 5.vi.73, M.S. Upton, SAMA; 2, Brock Creek Burnside N. Aust. 4 May 1929 T.G. Campbell, ANIC; 1, 100 mi. E. of Kununurra W.A., light trap 27.3.66 J.A. Mahon, ANIC; 1, Australia, N.T. Muirella Park, Kakadu 18.v.1987 Fay and Halfpapp at light, QDPIM; 2, Kowanyama, N. Qld., 9.i.1977, D.L. Hancock, QM; 1, at light Normanton Qld., 3 May, 1963 N.B. Tindale and P. Aitken, SAMA; 3, Hann Riv., N.Q. 100 mls S. of Coen, 23.vi.1970, J.c.le Souef, NMV; 2, 12°17′S 133°13′E. Birraduk Creek, N.T. 18 km E. of N. of Oenpelli 4.vi.1973, Upton and Feehan, ANIC.

Remarks

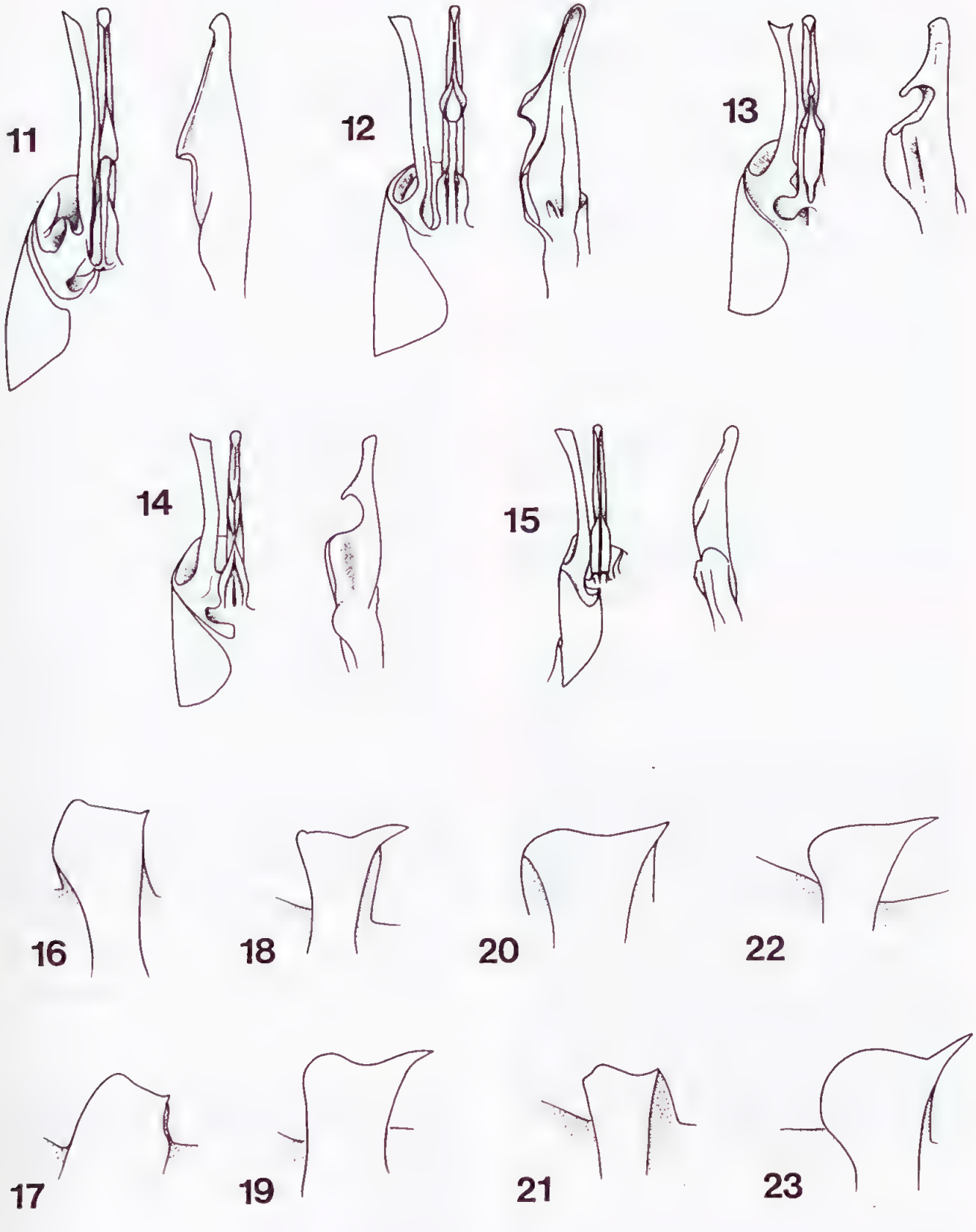
Separated most readily from other Australian species by the lack of, or virtual lack of, a spine on pronotal pillar. The aedeagus lacks or virtually lacks any trace of the deep dorsal notch present in the other Australian species.

Hydrobiomorpha helenae Blackburn

Hydrobiomorpha helenae Blackburn, 1890, p. 741; Knisch, 1924, p. 234; Mouchamps, 1959, p. 303.

Description (number examined 141). (Figs 1, 7, 8, 13, 18, 19)

Length 11–16 mm. Broadly oval. Predominantly black, front half of clypeus and appendages rufous yellow, elytra usually with alternating dark and light longitudinal stripes of green-grey separated by narrow black lines. This colour pattern of variable distinctiveness and sometimes lacking in which case elytra black. Head with evenly spaced, small, variably sized, sharply impressed, punctures and very fine reticulation; patches of much larger punctures inwards from eyes and in a rough semi-circle forward from each eye; hind margin of labium with a few large punctures; membranous area between clypeus and frons broad, wide, little restricted laterally; front portion of gula quite densely covered with strong punctures, back portion with fewer, particularly in midline, similar or smaller punctures. Pronotum punctured as on head with three obliquely slanted fields of large punctures on each side; groove along front edge reaching well beyond inner border of eye. Elytra covered in very small sharply impressed punctures, very finely reticulate and with five uneven rows of large setae-bearing puncture lines, the lateral ones with scattered, poorly aligned punctures. Sternal keel widely expanded in posterior half, sharply restricted between postcoxae to a short thin carinate point; front portion curving sharply upwards with notch well above plane of mesosternum. Meso- and metasternum and abdomen rugose-punctate except sternal keel, appendages and a small triangular bare



FIGURES 11–23. 11, dorsal view of aedeagus and left paramere and lateral view of aedeagus of *H. troxi*; 12, ditto, *H. debbae*; 13, ditto, *H. helenae*; 14, ditto, *H. bovilli*; 15, ditto, *H. microspina*; 16 and 17, lateral views of different pronotal pillars of *H. microspina*; 18 and 19, ditto, *H. helenae*; 20, ditto, *H. debbae*; 21, ditto, *H. troxi*; 22 and 23, ditto, *H. bovilli*.

patch at apex of apical abdominal sternite. Lateral wing of metasternum with narrow additional portion on front edge. Pronotal pillar broad in ventral view, with well developed backward pointing spine (Figs 18, 19).

Male

Protarsi slightly expanded, claws on all legs more sharply bent with bulbous basal portion. Joints of maxillary palpi expanded, robust, second joint greatly expanded and concave on ventral surface (Fig. 7). Aedeagus as in Fig. 13.

Distribution

Restricted to wet coastal areas from Derby to Bundaberg. Also in Papua New Guinea.

Types

Lectotype: M. 3030 N.T. T; Hydrobiomorpha Helenae, Blackb.; Blackburn coll. 1910-236, BMNH, herein designated.

Paralectotypes: F. 3030 N.T.; S. Aust. 90.11; Hydrobiomorpha Helenae, Blackb., BMNH; ? sex 3030; N. Territory, Hydrobiomorpha Helenae, Blackb. Co-type, SAMA, herein designated.

Additional localities

W.A. — Barradle, ANIC; Derby, WAM, SAMA; 90 ml. E. Derby, SAMA; Fitzroy Crossing, ANIC; 100Ml. E. Kununurra, ANIC; Mitchell Plateau, ANIC; Ord River, WAM; Windjana Gorge, ANIC; Wyandotte, ANIC; Wyndham, NMV.

NT — Adelaide River, ANIC; 31 km W.S.W. Borroloola, ANIC; Brock Ck Burnside, ANIC; Daly River Mission, ANIC; Darwin, NWV, SAMA; Groote Is., SAMA; Horn Islet, Sir Ed. Pellew Gp, EUQ; Howard Springs, ANIC; 17 ml. N.N.E. Borroloola, ANIC; Humpty Doo, QDPIM; Katherine, ANIC, UQIC; King River, NMV; Koongarra, ANIC; Oenpelli, NMV; Wessel Isl., ANIC.

QLD — Bloomfield River, EUQ; Bundaberg, ANIC; Cairns, SAMA; Cape York, QM; Cooktown, QM; Ingham, ANIC; Kowanyama, QM; Mornington Isl. Mission, SAMA; Mutchilba, NMV; Normanton, ANIC, SAMA; Saibai Isl., EUQ.

PNG — Morehead River, ANIC.

Remarks

Apart from *H. troxi*, which lacks the membranous portion between the frons and clypeus, *H. helenae* is the only Australian *Hydrobiomorpha* with alternating dark and light stripes on the elytra of most specimens and a widely expanded posterior portion of the keel. Some specimens, particularly large females lack the elytral stripes.

Hydrobiomorpha bovilli Blackburn

Hydrobiomorpha bovilli Blackburn, 1888, p. 816; Knisch, 1924, p. 234; Mouchamps, 1959, p. 305. *Hydrobiomorpha tepperi* Blackburn 1888, p. 817; Knisch 1924, p. 234; Mouchamps 1959, p. 305. Syn. nov.

Description (number examined 118). (Figs 2, 3, 14, 22, 23)

Length 11-17 mm. Narrowly oval, black; front of clypeus, membranous area on head and much of underside testaceous, small circular patches of grey around punctures on head, pronotum and elytra. Head finely reticulate, moderately densely covered with small fine punctures. A field of large punctures along inner border of eye, a rough semicircle in front of eye, a few large punctures along rear edge of clypeus and a couple in middle of clypeus. Membranous area between frons and clypeus broad, angularly restricted in lateral quarter. Pronotum sculptured as head, with oblique field of punctures in middle on each side and an oblique broken row towards the front on each side, groove along front edge of pronotum reaching beyond edge of eye. Elytron punctured as on pronotum, with five rows of relatively small serial punctures, the lateral three rows with sparser punctures, a few linear rows of small punctures visible in some lights towards apex. Sternal keel virtually same width throughout, produced into short sharp blunt point behind. Meso- and metasternum and abdominal sternites rugose-punctate except keel and quite large triangular to semicircular bare area at apex of apical sternite, bare area often longitudinally wrinkled. Pronotal pillar narrow in ventral view with strong slightly downward pointed spine (Figs 22, 23). Front portion of keel dipping sharply upwards in front of notch which is on same plane as rest of keel. Front area of gular region moderately covered with moderately sized punctures, rear portion with some much larger punctures on lateral portions, midline impunctuate.

Male

All claws sharply bent with bulbous area at base. Maxillary palps stouter particularly second joint which is expanded to about twice width of apical joint (Fig. 3). Aedeagus as in Fig. 14.

Distribution

A northern coastal species which is relatively common from the Northern Territory around to the Townsville - Home Hill region of Queensland. Also known from New Guinea.

Types

H. bovilli Blackburn. Holotype: F. 2310 N.T. T;

Hydrobiomorpha Bovilli. Blackb.; Blackburn coll. 1910-236. Mounted on cutaway card, in BMNH. Locality given as Palmerston N.T. by Blackburn (1888).

H. tepperi Blackburn. Lectotype: F. 2356 N.T. T; Hydrobiomorpha Tepperi, Blackb; Blackburn coll. 1910-236. On card. Card once contained two specimens, the right hand one labelled 'T' remains. In BMNH. Locality given by Blackburn (1888) as Palmerston N.T. Herein designated. Paralectotype: M. N. Territory J.P. Tepper Hydrobiomorpha Tepperi Blackb., in SAMA; N. Territory, Tepperi, Blackb., in SAMA. Herein designated.

Additional localities

QLD — Cairns, SAMA; 21 k N.W. Cooktown, ANIC: Home Hill, CW; 14 k N.W. Hope Vale Mission, ANIC; Ingham, QDPIM; Iron Range, ANIC, EUQ; Kowanyama, QM; Laura, ANIC, QDPIM; Mornington Isl., SAMA; Mt Baird, ANIC; Mt Webb Nat. Pk, ANIC; 38 k S. Musgrave, ANIC; Normanton, SAMA; Rounded Hill 15°17′S 145°13′E, ANIC; 40 k S. Weipa, QDPIM.

NT — Adelaide River, ANIC; Bentinck Isl., SAMA; Cooper Creek, ANIC; Darwin, CW; Dirraduk Ck, SAMA; Howard Springs, ANIC; King River, NMV; 16 k N.E. Mt Cahill, ANIC; 18 k N.E. Oenpelli, Sire Edward Pellew Gp, EUQ; 6 k S.W. Oenpelli, SAMA; Rimbija Isl., ANIC.

PNG — Morehead, ANIC; Rouku, Morehead River, ANIC; Weam, ANIC.

Remarks

The strong spine on pronotal pillar, relatively even width of keel and long groove on the front of the pronotum separate this common species from other Australian *Hydrobiomorpha*. The male maxillary palpi are not as expanded as in the related, but rather larger species, *H. debbae*.

Hydrobiomorpha debbae sp. nov.

Description (number examined 5). (Figs 6, 10, 12, 20)

Length 15-18 mm. Oval. Predominantly black; front of clypeus, membranous area on head, tarsi and appendages testaceous; punctures on elytra, particularly serial ones, are in the centre of small grey spots. Head with scattered fine punctures of varying size; very finely reticulate; row of setiferous punctures along inner border of eye, a field of extremely large punctures in front of eye, a few large punctures along rear edge of clypeus and a few scattered ones in middle; membranous area between frons and clypeus broad, narrowing rather slowly in lateral quarters (Fig. 10). Pronotum with very fine weak reticulation sparsely covered in fine punctures; three oblique lines of moderately large punctures on each side; groove along front edge reaching to level of middle of eye. Elytron with reticulation and punctures somewhat stronger and denser than on pronotum; with five rows of moderately large serial punctures, sparser in third row and lateral two close together. Sternal keel with hind portion a little broader than front portion, produced into a blunt point between hind coxae; front portion slopes sharply upwards in front of notch which is on approximately same plane as rest of keel. Pronotal pillar quite broad in ventral view, bottom edge produced backwards in short stout spine (Fig. 20). Front portion of gular area well covered in strong punctures, back portion similarly punctured except for small impunctate area in midline. Wings of mesosternum without additional portion on front edge. Meso- and metasternum and sternites rugose-punctate except for keel and triangularly shaped bare patch at apex of apical sternite.

Male

Protarsi a little expanded, all claws sharply curved and with a small bulbous portion at base. Second joint of maxillary palpus broadly expanded, concave beneath (Fig. 6). Aedeagus as in Fig. 12.

Distribution

Known only from the type localities on the eastern coast of Cape York.

Types

Holotype: M. Cairns dist. A.M. Lea, SAMA.

Paratypes: 1, Cape York Pen. Lockerbie N.Q., 9-15 April 1975. Coll. M. Walford-Huggins, CW; 1, Cairns, SAMA; 1, same data as Holotype, SAMA; 1, 'Bald Hills' Stn, 44 km N. of Isabella Falls, Qld., 15°15′S 145°00′E, 29 Dec. 1984 mv lamp, G. and A. Daniels, EUQ.

Remarks

H. debbae can be separated from *H. bovilli* by the short pronotal spine and short length of groove along front of pronotum, which seldom reaches to level of the inner edge of eye and is usually much shorter, the relatively short width of wide portion of membranous area at front of frons (Fig. 10) and the more strongly expanded second segment of male maxillary palpus (Fig. 6). *H. debbae* is generally longer and broader than *H. bovilli*.

ACKNOWLEDGEMENTS

The curators of the collections listed earlier are thanked for the free and rapid access to specimens in their care. Dr E. Matthews kindly read and improved the manuscript. Mrs D. Lowery typed successive versions. Miss J. Thurmer drew the illustrations and the Librarian of the S.A. Museum, Mrs M. Anthony helped with references. All of these people are thanked for their support and help.

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THE ARCHAEOLOGICAL SIGNIFICANCE OF THE LOWER COOPER CREEK

P. VETH, G. HAMM & R.J. LAMPERT

VETH, P., HAMM, G. & LAMPERT, R.J. 1990. The archaeological significance of the Lower Cooper Creek. *Rec. S. Aust. Mus* 24(1): 43-66.

A systematic survey of the Lower Cooper Creek has revealed an exceptionally rich record of prehistoric occupation, trade and subsistence strategies. Preliminary analysis of Holocene assemblages suggests significant differences in settlement/subsistence strategies between the floodplain unit and the dunefields proper, to the west. The location and dating of two hearths incorporated within dune cores clearly establishes a human presence in the central Lake Eyre Basin during the late Pleistocene.

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INTRODUCTION

It is something of a paradox that the Lower Cooper Creek, lying in the driest region of the Australian continent, should have an extraordinarily rich and diverse record of prehistoric human occupation. This apparent anomaly, however, can be explained largely by the periodic supply of huge volumes of water from a catchment originating in the eastern Highlands of central Queensland.

Although the catchment is 306 000 square kilometres the Lower Cooper only flows into Lake Eyre about once in every 10 years. To reach Lake Eyre the Lower Cooper passes through extensive dunefields of the Tirari Desert, an area receiving less than 125 mm of rain annually. Here the Cooper channel provides a string of pools and soakages which are differentially rejuvenated by both floodwaters and local rainfall, thus acting as a relatively well watered conduit through an intensely arid landscape (Bonython 1963).

During a six-week field season by Veth and Hamm, on a section of the Lower Cooper between the Birdsville Track and the eastern shore of Lake Eyre, 204 sites were recorded, the majority of which appear to date from the mid- to late Holocene. They include lithic scatters of varying complexity, stratified and deflated burials and hearths with ant-bed heat retainers, stone arrangements and a number of quarries with associated reduction areas.

Of interest on the Lower Cooper are frequent exposures of ancient flood plain sediments which contain a wide range of megafauna. The sediments date from Miocene to late Pleistocene times. Frequent exposures through these sediments have brought to light the remains of such aquatic species as lungfish and crocodile as well as such megafauna as diprotodontids, macropods and *Sthenuris*, fauna that provide evidence for previous lacustral phases when fresh water was abundant along the creekline (Wells 1986).

Climatic events witnessed in these sequences reflect global glacial cycles. Phases of high stream discharge and lake-full conditions are succeeded by dune building periods with aridity increasing towards the glacial maximum at 18 000 B.P. The periodic reactivation of this arid heartland has been summarised by Wells (1986: 101):

> The present desert landscape is one of ephemeral rivers, saline lakes and extensive dune fields. A sparse woodland survives along the ancestral river valleys. Beyond the valleys the great dunefields of the Tirari and Simpson Deserts sweep away to the north. In years of high rainfall the streams are rejuvenated. Lake Eyre floods and teems with fish and birdlife much as it has throughout the Pleistocene, only the crocodiles seem to be missing.

Three floodplain sedimentary units are exposed along different sections of the Lower Cooper channel. The oldest of these, the Tirari Formation, dates from the late Pliocene, and an intermediate unit, the Kutjitara, dates from the Middle Pleistocene. Only the youngest unit, the Katipiri Formation, could have relevance for the potential presence of early humans, although a terminal date around 80 000 B.P. is indicated (Tedford *et al.* 1985; Callen & Nanson 1989). Mammals represented in the Katipiri Formation on Cooper Creek include the now extinct *Sarcophilus, Thylacoleo,*

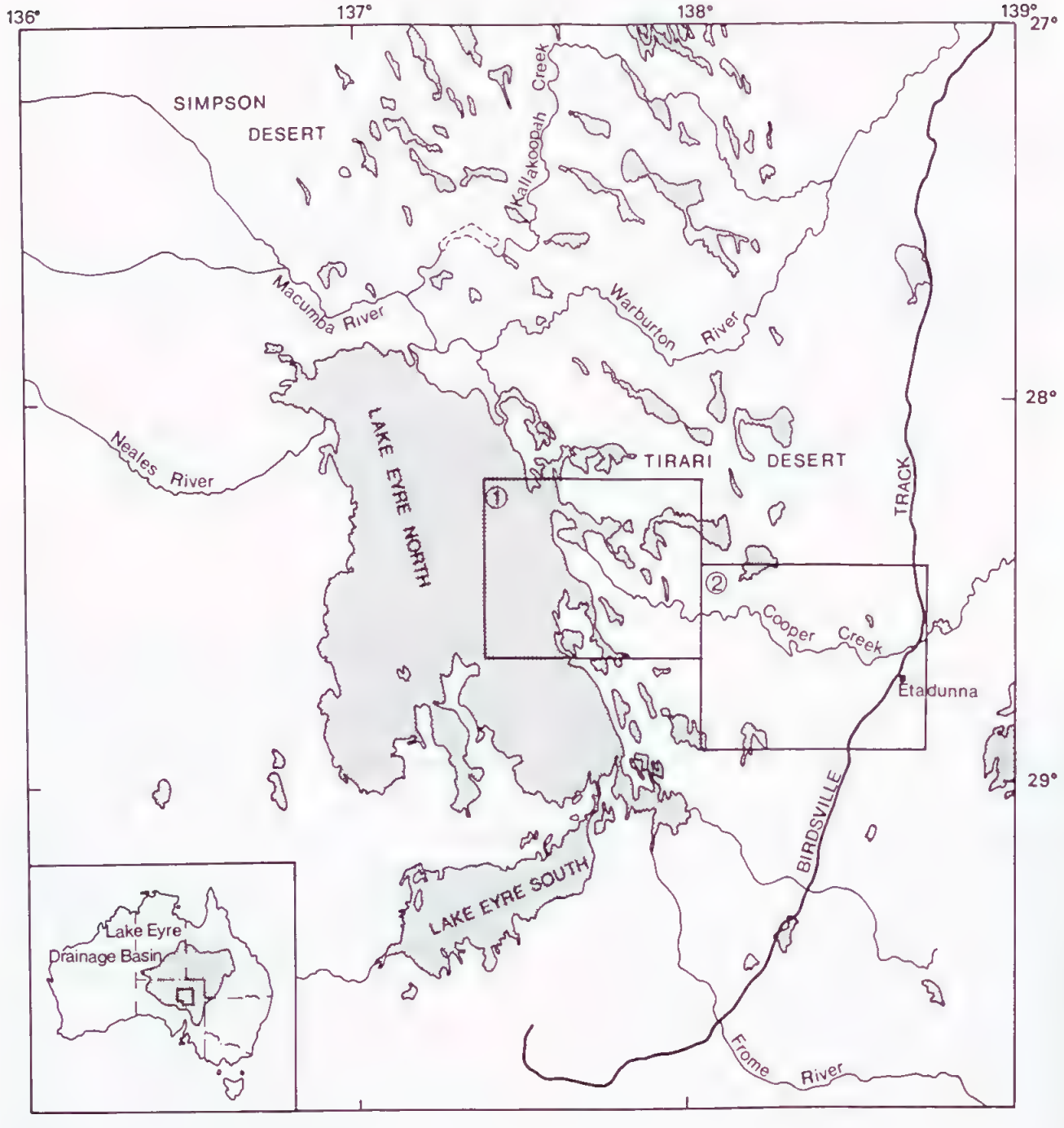

FIGURE 1. Regional context of Lower Cooper survey area. Map insets comprise Figs 2 and 3.

FIGURE 2. Location of archaeological sites, Lower Cooper Creek (inset 2).

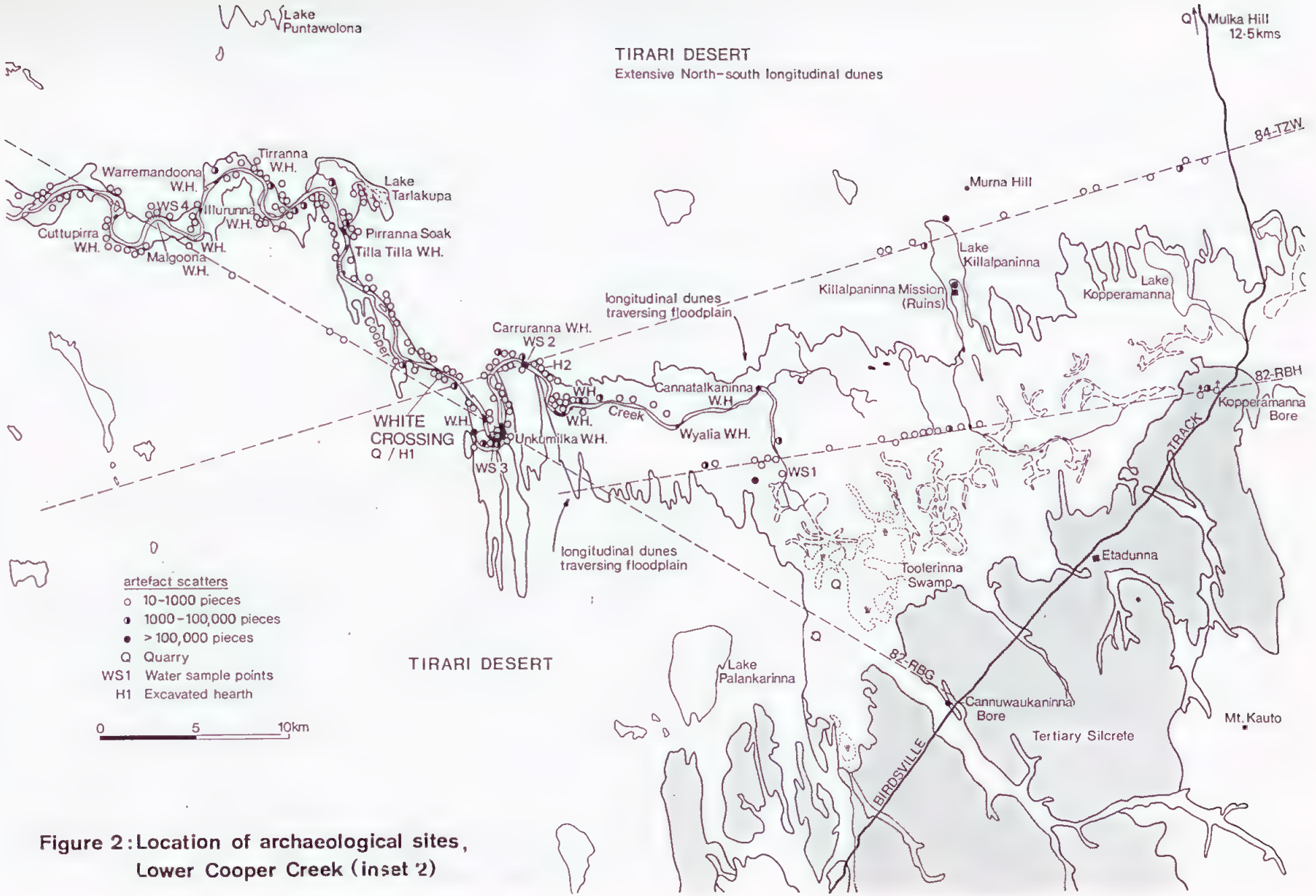

Figure 2: Location of archaeological sites, Lower Cooper Creek (inset 2)

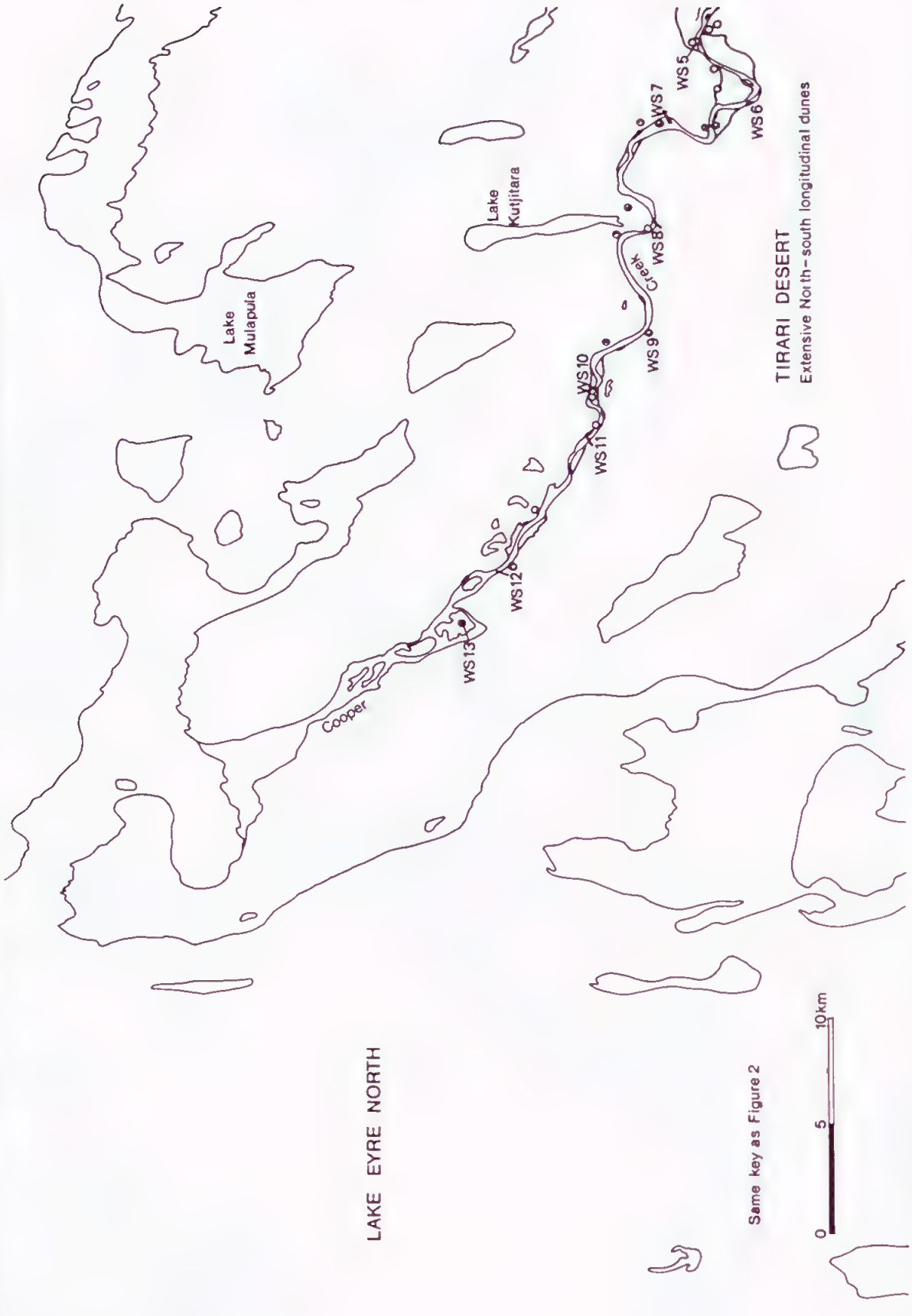

Figure 3: Location of archaeological sites, Lower Cooper Creek (Inset 1)

FIGURE 3. Location of archaeological sites, Lower Cooper Creek (inset 1).

Diprotodon, Protemnodon, Sthenurus and *Procoptodon* (Stirton *et al.* 1961). As Lampert *et al.* (1988) noted for Katipiri exposures along the Warburton, our systematic survey of these sediments along the Cooper did not reveal any cultural material *in situ*.

Of greater relevance to the generally accepted time for human occupation in the Lake Eyre Basin are widespread occurrences of calcreted dune cores, well exposed along the Lower Cooper channel through the deflation of overlying Holocene sands caused by stock and rabbits. The calcrete units can contain rhizoconcretions and nodules of calcrete as well as mammal remains and egg shell. While calcreted dune cores have been dated in two places to 34 700 B.P. and 40 000 B.P., on egg shell carbonates, their formational histories are still poorly understood (Wasson, pers. comm.). Finally, many deflated areas within the Holocene sands of the present dunefield expose lower, indurated levels which overlie the calcrete unit.

To date we have recorded three probable hearths and three burials clearly within Pleistocene calcrete units. Two of the hearths, located five kilometres apart (Fig. 2, H1 and H2), were tested and have returned dates of 11 830±320 B.P. (WK-1509) and 11 770±180 B.P. (WK-1510). Both flaked and edge-ground artefacts, as well as burials, have also been recorded within the later and presumably Holocene indurated dune unit. The results of this systematic archaeological survey of the Lower Cooper Creek provide substantial evidence for the presence of humans during the late Pleistocene in the interior of the Lake Eyre Basin.

Recent research in different areas of the arid zone, including both regional survey and excavation, has provided new perspectives on both the timing and the variability of arid zone adaptations. These stand in stark contrast to the previous archaeological assumptions (*cf.* Gould 1977) for conservative and unchanging cultural, economic and demographic behaviour within Australia's deserts (Hiscock 1989; Lampert & Hughes 1988; Smith 1986, 1988; Veth 1987, 1989a, 1989b; Williams 1988). The notion of a conservative desert culture is now, from an archaeological point of view, well and truly dead.

There are a number of relevant research questions which may be addressed by the data collected from the archaeological survey of the Lower Cooper Creek and these are outlined below.

With a reliable near basal date of approximately 21 950±270 B.P. at Puritjarra Rockshelter (Smith 1988: table 4.3) there is concrete evidence for Pleistocene occupation, albeit ephemeral, on the rim of the Lake Eyre Basin. A further date for human occupation of 15 270±210 B.P. has also been obtained from a rockshelter, Cuckadoo 1, located some 20 km south of Cloncurry in semi-arid Queensland (S. Sutton, pers. comm.). Further dates from Puritjarra, between a vertical gap separating the 21 950 B.P. near basal level and a higher level dated to 12 020±240 B.P., of 17 460±840 B.P. and 13 080±260 B.P. (Smith 1989), suggest some continuity of occupation in the permanently watered 'refuge' of the Cleland Hills. When the interior of the Lake Eyre Basin was actually colonised is currently a matter for debate, especially given the relative dates of greater than 40 000 B.P. claimed for an unstratified fragment of cranial vault from the Warburton River, east of Lake Eyre (Webb 1988). Clearly, a sequence of absolute dates on cultural assemblages from the interior of the Basin is needed before inferences can be made about human behaviour in the region during the late Pleistocene.

If the minimum end of Webb's relative dates for humans is accepted it is appropriate to ask whether this occupation represents a specialised adaptation to the relatively well watered drainage systems feeding the Lake Eyre megalake, or if prehistoric economies would have been generalised allowing widespread use of all land systems, including the extensive dunefields, sandsheets and margins of the saline playas? If there was early occupation, did it continue during earlier dune building phases through to the height of the glacial maximum and especially between 20 000 and 16 000 B.P. (*cf.* Bowler & Wasson 1984)? The mobilisation of dunefields, lowering of regional water tables and local restriction or extinction of potentially economic plant and animal species during the glacial maximum would have caused severe stress, even to small and highly mobile groups. The recently proposed biogeographic model for the colonisation of the interior of Australia views the occupation of the arid zone as a dynamic process with significant changes in the climate and hydrology of the interior, from after 40 000 B.P., forming a backdrop against which changes in demography, economy and social organisation occur (Veth 1989a).

These changes essentially result in some regions being permanently occupied before and during the height of the glacial maximum while others, such as the lowland sandsheets surrounding Lake Eyre, are predicted to have been abandoned during the period from 20 000 to 16 000 B.P. It is significant that sediments spanning both lacustral and arid phases are well represented along the Lower Cooper Creek and that spatially, these units might be logically correlated with former occupation loci. That the terminal Pleistocene series are less well expressed than overlying sediments is fully acknowledged, as are the limitations inherent in making quantitative comparisons of cultural assemblages between these units. It is still extremely

productive, however, to note such obvious trends as the total absence of material in some units and its presence in others, especially if this is repeated over a wide geographic area.

In terms of Holocene occupation patterns, previous work in the Lake Eyre Basin within the Simpson Desert (Hercus & Clarke 1986; Smith 1988), the Strzelecki Desert (Lampert & Hughes 1980, 1987, 1988), the Cooper Creek floodout zone (Williams 1988), the Warburton River (Lampert 1988) and the mound spring complexes (Florek 1987; Hughes & Lampert 1985) has documented a plethora of sites assigned to the mid- to late Holocene. Only a few, low density assemblages have been dated to the terminal Pleistocene/early Holocene (Lampert & Hughes 1988; Wasson 1983). The apparent increase in the number of occupation sites within the Lake Eyre Basin during the late Holocene correlates with significant increases in the rate of artefact discard noted from other stratified rockshelter and cave sites within the arid zone. Three stratified sites within the Little Sandy Desert, for which depth/age curves were constructed, all show a consistent trend in increasing rates of artefact discard, accelerating during the period 1400 to 800 B.P. (Veth 1989b: figure 6.12). This pattern is almost identical to that noted by Smith (1988: 315) from central Australian sites, where a significant increase in the density of flaked stone artefacts, grindstones, charcoal and bone is noted between 1400 and 600 B.P. It is therefore relevant to ask whether the same pattern of relatively intense late Holocene occupation occurs along the Lower Cooper, especially given the better than usual visibility of older sediments.

It was noted by Lampert (Lampert *et al.* 1988) that there was variation in the proportions of formal implement types between habitation sites on the Warburton River. Such variability between assemblages might be expected due to differences in the functions of sites. If it is assumed that the procurement and use of resources, be they lithic, plant or animal, are embedded within an overall economic system, then the functionally specific nature of sites can be accepted (*cf.* Binford 1980). Here, the function of sites is seen to reflect the repeated presence of different activity sets that might be associated with encampments of varying numbers of people and of varying residential permanency. An extreme example would be the differences that might be expected between major aggregation and redistribution sites (for trade goods) as opposed to ephemeral habitation camps. Assemblages from the Lower Cooper can be constructively examined for possible differences in reduction strategies as these reflect differences in social and economic behaviour (*cf.* Hiscock 1989). Also structuring the archaeological assemblages, although probably of lesser importance, are various behavioural responses to increasing distance from raw material sources; i.e. decreasing procurement efficiency. These behavioural responses may include more stringent criteria for discard (Byrne 1980), rationing (Hiscock 1984), use of alternative materials (O'Connell 1977) and more efficient reduction strategies (Bird 1985). These issues may be actively pursued along the Lower Cooper as there are well provenanced supply zones for many of the raw materials from which artefacts found on occupation sites have been manufactured. A range of ochres, bivalves, axes and sculptured stone objects found on the open sites are also known to have sources well outside the study area (McBryde 1989, pers. comm.; McConnell 1976).

Relevant questions for the Holocene might include, to what extent are habitation base-camps tethered to the more reliable water sources along the creek and to what extent do these differ from habitation sites located away from drainage lines in the dunefields and adjacent intermittent claypans and playas? Is habitation focused along a riverine 'conduit' through an otherwise harsh landscape or is there evidence for widespread use of all land systems within the Tirari Desert? Are these settlement patterns likely to have changed through time? Is there evidence for different settlement patterns with movement west along the Cooper Creek towards the shores of Lake Eyre and away from extensive swamp and floodplain systems? What are the significant changes in the structure of artefact assemblages with movement further west away from raw material supply zones? What is the archaeological evidence for long distance trade and exchange and what does this imply about social relations between the resident dialectal group, the Diyari, and adjoining language groups? Is it possible to identify a 'core' territory for the Diyari from the archaeological record and how does this relate to ethnographic and ethnohistorical accounts of demography and economy? Is there evidence in the archaeological record, from predominantly open sites, for an increase in population in the late Holocene? What are the likely mechanisms for an assumed late Holocene increase in population and how is this related to the extensive trade and exchange networks known to have operated through the Lower Cooper at contact? These and other questions can all be viewed within the broader framework of humans gradually recolonising the arid sandy lowlands from the refuges of the glacial maximum; refuges such as the Flinders Ranges and the central Australian Ranges (after Veth 1989a). It is possibly only by the terminal Pleistocene that groups colonising areas such as eastern Lake Eyre would have become truly adapted to arid conditions and developed regionally unique economies and

social structures which eventually produced the diversity of ethnographic desert cultures.

Settlement and Subsistence Modelling for the Lower Cooper

The Lower Cooper passes through the boundaries of the Diyari and Thirrari language/dialectal groups (Hercus 1987, 1988; O'Grady *et al.* 1966; Tindale 1974). While Thirrari has been argued to represent both a 'horde' (Howitt 1904) and a dialectal variant of Diyari (Austin 1981) the fact that the territory flanking the eastern shore of Lake Eyre and east along Cooper's Creek was part of a Diyari emic geomorphic distinction (Karling-alpa, *cf.* Wilson 1981: 51) suggests that at least a different pattern of settlement may have operated in this less watered country. Indeed, the boundary 'separating' Diyari territory from that of Thirrari marks the boundary between gibber plain and sandhill geomorphic units (Wilson 1981: figure 4). In simple terms, the section of the Lower Cooper channel and its floodplain, east from White Crossing and lying within Diyari territory, is relatively well watered and contains several large swamp systems, a string of semi-permanent pools and an extremely broad system of claypans and floodplain flats (Fig. 2).

Both Lake Killalpaninna and Lake Kopperamanna occur within this zone. By contrast, the western section of the channel, from White Crossing to Lake Eyre, has a negligible floodplain and the waterholes tend to be smaller, more discrete and of increased salinity (Fig. 3). It is significant that Cooper Creek and its floodout lakes, further north and east into Diyari territory, are seen historically to have been the main focus for regional settlement, on the basis of sightings of large numbers of people and semi-permanent camps (*cf.* Williams 1988: 56) and the highest density of named places on the Hillier map (Reuther 1981 in Wilson 1981: 87). The swamplands and lakes of the eastern portion of the Lower Cooper are seen to be most analogous to these 'core' Diyari areas.

A number of conclusions about settlement and subsistence behaviour from the Lakes area have been made by Jones (1979) and, on the basis of these, several archaeological predictions have been offered by Williams (1988). In summary, Jones argues for groups closely tethered to the rivers and lakes, penetrating somewhat opportunistically into the dunefields after rain. The sandhill unit is argued to be more productive, for plant foods and small mammals, than the lakes and rivers and these, in turn, are seen to be more favoured than the stony country. After viewing Jones' model, Williams (1988: 57) predicts that:

> . . . the largest sites will be found in areas which have permanent or semi-permanent water sources. Surface campsite material will be found in the dunefields but sites will be smaller than those on the margins of lakes and permanent waterholes.

While at a general level these predictions appear to be supported by Williams' survey of Coongie Lakes, it seems useful to predict in more detail what some of the differences in artefact assemblages between landform units might be, other than just size, as a result of different structuring of economic plant and water resources. Such assemblage differences might include variation in both formal implement and debitage classes as a reflection of different reduction strategies; strategies indicative of the site's role within a specific settlement system and its spatial relationship to key economic resources such as water, lithics and economic plants.

Hydrological and Rainfall Data

The precipitation patterns around Lake Eyre have been characterised in detail by Tetzlaff (1976). Over a 90 year period the long term precipitation is the lowest for the continent at approximately 120 mm per year. Although frequent shifts in mean circulation patterns cause variability in rainfall, a trend is noted in which maximum rainfall occurs in February with the minimum in late winter (July and August). A second weak maximum is noted in spring with another period of little or no precipitation in December. Most importantly, the rainfall in the Lake Eyre region only contributes a small amount to each flooding of the lake. Intermittent waterholes along the Cooper channel are clearly rejuvenated by local rainfall, however, either by direct run-off or by slow circulation of freshwater from saturated source-bordering dune and alluvial sediments. The importance of these saturated sediments in providing potable water through soakages, when the free-standing water becomes saline, is stressed in historical accounts (*cf.* Gregory 1906).

To characterise the quality of both surface and subterranean water sources along the Lower Cooper in more detail, we arranged for a series of controlled hydro-geological measurements to be taken at both pools and freshly dug soakages at intervals between the Birdsville Track and the shores of Lake Eyre; Locations WS1 to WS13 (Figs 2 and 3). The results of chemical analyses and electrical conductivity readings at both waterholes and soakages (made by John Noonan at the School of Earth Science, Flinders University) are shown in Table 1. The known upper tolerance for humans is 2–5 mS. At the time of our survey potable water could only be obtained from the three easternmost water sample points, significantly all located to the east of White Crossing within the broad floodplain unit. Interestingly, much lower readings were obtained

from soakages than from directly adjacent pools at all water sample locations. The consistently lower readings for soakage water support the notion of relatively fresh sub-surface water supplies. A mechanism for the replenishment of subsurface waters has been proposed (Noonan, pers. comm.) in which floodwaters, having scoured the creek bed of salts, saturate the remaining clean quartz levels as water velocity drops, and become entrapped under a slowly setting silt/clay blanket. Many of the saline pools of the Cooper Creek probably post-date flooding and actually lie on top of this impermeable skin. Water falling on source-bordering dunes could seep under the clay horizon, rejuvenating the entrapped waters.

Limited bore hole data, from the South Australian Department of Engineering and Water Supply, also provide evidence for an extremely high local water table at the important occupation site of Unkumilka Waterhole within the eastern flood-plain unit (see Fig. 2).

A range of sources (Bonython 1955, 1963; Litchfield 1983; Madigan 1946, Mason 1955) note that between 1885 and 1984 at least one portion of th Lower Cooper probably flowed some 25 times. These waters probably reached Lake Eyre at least five and possibly as many as 20 times. Many of the accounts note that the floodwaters coming down as far as the Lower Cooper often only reached Lakes Kopperamanna and Killalpaninna in the vicinity of the Birdsville Track (see also Mollemans *et al.* 1984, Appendix 2). As Gregory (1906: 59) notes of Lake Killalpaninna:

> [It] is a veritable oasis in the wilderness. The lake, unlike most of the so-called lakes in this country, actually contains some water . . . When full, the lake water is fresh and photographs taken of the mission at such periods show that the situation is then quite picturesque.

Bonython (1963) has documented the progress of a typical flood which reaches the shores of Lake Eyre. At the end of March, heavy rains occurred at the headwaters of the Cooper and Diamantina, following on from minor falls in January. By April 19th the Cooper flood had reached Innamincka in South Australia. The flood then reached the Coongie Lakes (already holding water from an earlier flood) and went to Kanowana by May 9th. The flood was halted for a period of 10 days here and then by May 20th was moving again to reach Lake Hope. After being held here for two weeks it finally reached the Birdsville Track at Kopperamanna on July 10th. By July 15th, the flood had reached Lake Killalpaninna, where it was held up for two further weeks while filling the floodout area (e.g Toolerinna Swamp, see Fig. 2). Around July 28th the Cooper appeared to burst through a veritable dam, reaching the shores of Lake Eyre by August 8th.

This, and other accounts, suggest that the Kopperamanna and Killalpaninna floodout zone was reached more often than the western half of the Lower Cooper Creek, and in turn that the Lower Cooper as a whole flooded less often than the Coongie/Kanowana region. On the basis of the hydrological data there appears to be further reason for delineating a 'boundary' between Thirrari and Diyari territory along the central portion of the Lower Cooper.

TABLE 1. Chlorine content and electrical conductivity of water samples taken from waterhole and soakage sample points (WS1 to WS13), Lower Cooper Creek (Figs 2 and 3).

Location	Dist. Downst. (km)	Cl-WH (mg/l)	Cl-Soaks (mg/l)	EC-WH (mS)	EC-Soaks (mS)
1	0	337		0.630	
2	22	4970	1278	13.300	3.200
3	27	2272	781	13.000	2.600
4	62	46150		104.200	
5	76	92300		126.000	
6	82	53250	6745	110.300	56.300
7	89	134900	46150	131.600	39.300
8	98	67450		126.400	
9	105	81650		125.800	
10	111	113600	23430	128.900	20.900
11	113		8165		16.800
12	121	184600		117.600	13.000
13	125	198800		115.400	

Economic Plant Species

A wide range of economic plants are likely to have been available to the prehistoric occupants of the Lower Cooper Creek. Notwithstanding the recent changes in the ecology of the area, a number of sources, including ethnohistorical and ethnographic records (*cf.* Gason 1879; Cleland & Johnston 1943a, 1943b), recent vegetation surveys of the Lower Cooper (Badman, n.d.) and adjacent areas (Mollemans *et al.* 1984) and comparative ethnobotanical data from similar desertlands (Clarke n.d.; Walsh 1987a, 1987b), illustrate that at least 30 seed and fruit-bearing species were available in addition to five rootstocks and a variety of fleshy-leafed herbs. Contrary to Jones' (1979) assumptions about the comparatively high productivity of the sandhill country of the Cooper Lakes districts, the distribution of economic food species in the Lower Cooper region appears to be fairly even between the sandhill and floodplain land units. Indeed if the quantitative ethnobotanical data available from the central and northwestern arid zone is examined (O'Connell & Hawkes 1984; Walsh 1987a; Kalotas, pers. comm.), in relation to the comparative productivity of different landform units, it is clear that it is at the ecotone between the drainage line and sandplain units that the greatest richness and diversity of economic plant foods occur. The arguably greater productivity of these environmentally fine-grained riverine 'conduits', however, in no way diminishes the importance of the extensive and easily accessible seed stands of the dunefields which are well documented as having comprised major groups of staples (*cf.* Veth & Walsh 1988).

On the available evidence, the majority of economic plant species are likely to have yielded edible components between March to November with the period of lowest productivity assumed to coincide with the intensely hot summer period. The period of greatest economic plant productivity follows several months after the highest average monthly rainfall. From March on, a number of seed-bearing species would be available with the later (winter) addition of further seeds, fruits, herbs and acacias. While rootstock are available all year, they are documented to be most palatable during and after periods of high local rainfall. Acacia seeds are likely to be available well towards and into summer, both on the plant and as seedfall. The deliberate storage of hard coated species for the lean summer months may also have occurred (*cf.* Veth & Walsh 1988).

Faunal Resources

Large fauna appears to have been virtually absent from Diyari and Thirrari country (Gason 1879: 278; Johnston 1943; Jung 1877: 70). Instead, medium and small marsupials which could survive without permanent surface water were commonly exploited. These included the bilby *(Macrotis lagotis)* and lesser bilby *(M. leucura)*, the desert rat kangaroo *(Caloprymnus campestris)*, the hopping mouse *(Notomys cervinus)*, the native cat *(Dasyurus geoffroii)* and the marsupial mouse *(Sminthopsis crassicaudata centralis)*. Quail *(Coturnix novaezelandiae pectoralis)*, a range of ducks *(Anas superciliosa, Chenonetta jubata,, Dendrocygna eytoni, Tadorna tadornoides* and *Aythya australis)* and teal *(Anas gracilis)* are also noted to have been a food source, in addition to the plumage being used in ceremony (*cf.* Gason 1879; Howitt 1891). Reptiles exploited included the woma python *(Aspidites ramsayi)*, the death adder and brown snake *(Acanthophis antarcticus* and *Pseudechis australis)*, the bearded dragon and sleepy lizard *(Pogona barbata* and *Trachydosaurus rugosus)*, the perentie *(Varanus giganteus)* and Gould's goanna *(Varanus gouldii)* (*cf.* Gason 1879; Berndt & Vogelsang 1941; Johnston 1943). The water holding frog *(Cyclorana platycephala)* is noted as a food source, being also a totem for some Diyari groups (*cf.* Gason 1879; Howitt 1904). Numerous other smaller frogs and lizards are also recorded in the ethnohistorical sources.

Apart from the majority of the birds, which would only be seasonally abundant on the Lower Cooper, the medium and small marsupials, reptiles and amphibians (while fluctuating in numbers) would be generally available across most landform types in the study area. There is no sound reason for viewing the sandhills as being depauperate in fauna after local rains in comparison to the floodplain flats (*cf.* Jones 1979: 151–154). The riverine/sandhill interphase is still likely to have had the greatest diversity and richness of economic fauna.

Distribution of Lithic Resources

There are sources for three classes of lithic material represented in the artefact assemblages of the Lower Cooper. These sources are spatially discrete and it is therefore possible to define 'supply zones'. The dominant lithic material at most sites comprises fine to medium-grained silcrete. Large exposures of Tertiary silcretes outcrop on extensive gibber surfaces at the eastern margin of the study area (Forbes 1974). The westernmost extension of the silcretes approximates the route of the Birdsville Track (see Fig. 2). The silcrete commonly takes the form of large gibber nodules up to 20 cm in diameter. Flaked gibber nodules, reduction areas and decortification flakes were noted in numerous places over the Tertiary silcrete unit. There are no exposures of silcrete along the Lower Cooper between this unit and the shores of Lake Eyre.

Another stone material found on sites, and dominant at a few, is a white siliceous calcareous mudstone outcropping as part of the Etadunna formation. Only several outcrops are documented in the Lower Cooper region; one at White Crossing on the channel itself and several others on the margins of lakes such as Palankarinna (see Fig. 2). The exposure at White Crossing has clearly been quarried and reduction areas are visible on the upper slopes of adjacent banks.

Finally, there is a variety of Cretaceous and Tertiary sandstones which are also located on lake margins in the region and which appear as whole and fragmented grinding material on open sites. Other raw materials found on sites, yet which have no known local source, include chalcedony, a range of cherts and Innamincka-quality red-brown sandstone. The trade of the high quality Innamincka sandstone into the Lower Cooper area is discussed below.

Trade

Wilson notes that the Diyari, and it can also be assumed here, the Thirrari, had to procure many raw materials from outside their territory (Wilson 1981: 69). The most notable of those traded into their territory included large boomerangs, stone axes, grinding stones, softwood shields, various ochres, pituri and gum (*cf.* Jones 1984; McConnell 1976; McBryde 1989). These were also obtained through expeditions to the sources of these materials. It appears that the Diyari were intermediaries in a large trade network which focused on the Middle Cooper Creek region (Howitt 1904). Grindstones and red ochre are known to have been procured from the western flanks of the Flinders Ranges at Parachilna (Howitt 1904: 711–12; Jones 1984) and millstones to have been obtained from Innamincka amongst other regional sources (see McConnell 1976: figure 19). The characteristic red-oxide sandstone grinding blanks which have been recorded at the Innamincka quarries (Luebbers, pers. comm.) are often found as partial and fragmented grinding bases on many of the Lower Cooper habitation sites. Their mineralogical similarity has been confirmed by recent petrological analysis (McBryde, pers. comm.). This grinding material was highly prized, as Reuther (quoted in Wilson 1981: 70) notes:

> These millstones are brought from Jidniminka (Innamincka) for the purposes of trade. The Jandruwanta and Jauraworka people are owners of this stone-pit, which is of great importance to them for the bartering trade.
> A good millstone passes for a considerable fortune. In the first place, one has to pay heavily for it; what is more it is not a trifling matter to carry such a (large and heavy) stone on the head. Many an older brother has traded his sister for a good millstone.

Two ochre samples collected from open sites located west from White Crossing have been analysed by x-ray diffraction in order to characterise their mineralogy and assess regional quarry sources. One of these, a red ochre fragment (CC61) comprises major quartz (Si02) and hematite, trace feldspar and kaolinite. The other, a yellow ochre fragment (CC66) is described as major goethite (FeOOH) with minor quartz and kaolinite. A sample of red ochre from the famous Parachilna quarry of the northern Flinders Ranges demonstrated a major dolomite [CaMg (CO3)] phase with minor hematite (Fe203) and trace calcite (CaCO3) (Raven, pers. comm.). Clearly the regional sources are mineralogically diverse and more sampling at the known quarries (*cf.* McConnell 1976: figure 14) is required before meaningful statements about exchange routes for ochre can be made.

Other trade items found on some of the Lower Cooper sites, in addition to ochre and grinding material, include edge-ground axes, valves of the freshwater mussel *(Velesunio wilsonii)* and a cylcon. Several of the axes have been thin-sectioned and comprise dolerite, probably from a major quarry source, such as at Mt Isa, Queensland (McBryde, pers. comm.). The mussel valves are likely to have originated upstream from an area such as the Coongie Lakes, while the source of the cylcon, manufactured from calcareous sandstone, is unknown.

The exchange networks of the Lake Eyre Basin linked the two extremes of the Australian continent, from Spencer Gulf in the south to the Gulf of Carpentaria in the north. Ceremonies, song and both sacred and mundane knowledge also moved along these trade routes (*cf.* McConnell 1976). The adaptive significance of these massive reciprocity networks has been elegantly summarised by McBryde (1989: 174), who notes:

> . . . some anthropologists have seen the long-distance desert trading networks as adaptive, social mechanisms for desert survival rather than economic mechanisms for coping with environments where resources are sparse and lack diversity.

Proposed Settlement/Subsistence Strategy for the Lower Cooper

Here, we propose a land-use model which aims to predict landform associations which would have provided access to reliable water and plant resources and which are likely to have been targeted most often for both residence and foraging. In other words, predictions are made for those areas which

are likely to have been the site of relatively large and/or long term occupation and which are likely to reflect more complex and varied economic/social behaviour. Other areas are also identified which are likely to have been used in a transient mode and, finally, those portions of the landscape which would only have been used for task-specific activities (i.e. not for residence) are predicted. This model ultimately aims to make general predictions about the complexity of economic and social behaviour that might be expected in different parts of the Diyari/Thirrari landscape. The model is only applicable to the period after climatic amelioration following the glacial maximum, that is after 14 000 B.P. Although climatic oscillations are recorded for this period, they are minor compared with those preceding it (*cf.* Tedford *et al.* 1985). It is assumed that the area would have been abandoned by humans, as would many sandy lowland plains of the arid zone, during the height of the glacial maximum, i.e. 20–16 000 B.P. (*cf.* Smith 1988; Veth 1989a, 1989b). The possibility of human occupation in this area before 25 000 B.P., the time of the onset of intensified aridity, is raised only by Caldwell and Webb's claim for relative fluorine dating on a fragment of human cranial vault to greater than 40 000 years (Caldwell & Webb 1988: 10).

The provisional settlement/subsistence model for the Lower Cooper region may be summarised, as follows:

The ecotone between the dunefields, floodplains (including the few freshwater lakes and swamps) and drainage course of the Lower Cooper represents the most productive habitat for plant food staples and for structural materials for shelter, storage and the manufacture of mundane and non-secular wooden artefacts. It is also the site of the largest and most reliable water sources, both in the form of free-standing pools and as subterranean soakage. Where the floodplain is widest and the dunes either abut or partially traverse it, the widest range of staple plants with the most evenly staggered fruiting and seeding times will be accessible to resident groups. These associations are found along the Lower Cooper course from approximately Toolerinna Swamp, west, to the vicinity of White Crossing (see Fig. 2).

The ecotone between the dunefields and drainage course, in the absence of a significant floodplain, will be less productive for plant-food staples and certainly for structural materials. Potable water sources are more sporadic with a trend towards higher salinity. Permanent soakages are rare. This association is found along the Lower Cooper from approximately White Crossing, west, to the shore of Lake Eyre (see Figs 2 and 3).

The homogeneous dunefield landscape unit, in itself, is seen to be the least productive. Although the dunefields provide a wide range of staples (particularly seeds) some time after local rains, their distribution will be sporadic. Both (ephemeral) water sources and fauna may also be assumed to be widely distributed within this landform. Although more permanent interdunal soaks may occur at a distance from the Lower Cooper, it is unlikely they were common, given the lack of reference to them in historical records and the fact that none were intersected during survey transects through the dunefields.

It is predicted that it is at the ecotone of the dunefields, floodplain and drainage courses that the most 'intensive' occupation will have occurred. These areas would have been the loci for major aggregations of people and also of continual use throughout the emic resource calendar. Aggregation cycles may have followed a loosely seasonal pattern, peaking with the local abundance of water and plant staples from March to August. These localities should reflect more complex and varied economic and social behaviour. The ecotone between the dunefields and the drainage line of the western section will sometimes have been the site of large basecamps, however these will be strongly focused on more intermittently spaced water sources. Less intensive occupation might be expected along adjoining portions of the creek lacking reliable water sources. Finally, habitation sites will only be located in the homogeneous dunefields where ephemeral water sources occur and these sites will reflect less intense and variable economic and social behaviour than those on the drainage lines. All other sites located within the dunefields, away from water sources, are assumed to be task-specific and to reflect either resource procurement or maintenance activities. Many of these predictions can be tested, as demonstrated later in this paper, through an analysis of assemblage variability.

Survey Strategy

Given that the survey aimed to characterise occupation patterns both at and away from the Cooper drainage course, a number of complementary survey strategies were employed. A corridor of approximately 500 m each side of the Creek from Toolerinna Swamp to the shore of Lake Eyre was surveyed intensively. Linear traverses were made on foot at intervals of up to 100 m apart, these being parallel to the drainage course.

Transects at a remove from the Cooper Creek were usually aligned along seismic tracks, which run approximately east/west from the Birdsville Track to Lake Eyre. While not always running parallel to the creekline, they offered controlled samples intersecting the extensive north-south oriented dunes.

Those surveyed were located up to 5 kms from the creekline, with an average distance of 3 km. These transects were 100 m in width (major seismic routes are shown in Fig. 2). Several 100 m wide transects were also made at right angles to the creek down interdunal corridors. These were made to the north of the creek terminating at Lake Tarlakupa and to the south of the creek at Unkumilka Waterhole and at Malgoona Waterhole.

It is estimated that approximately 125 km^2 (125 km x 1 km) of the riverine conduit was surveyed. A total of approximately 50 km^2 of the sandhill landform was surveyed. Further transects through the dunes and around the large saline lakes are planned.

Description and Patterning Sites

Introduction:

A total of 204 archaeological sites were recorded during the 1989 field season on the Lower Cooper Creek. These are all open sites, the majority of which are lithic scatters of varying size and complexity. The location of these sites is shown in Figs 2 and 3, and the estimated number of artefacts in each is broken into three size ranges (see key). The study area is divided into four analytical units:

(i) the western drainage system (no. of sites = 101);
(ii) the western dunefields, all west of White Crossing (no. of sites = 3);
(iii) the eastern drainage system (no. of sites = 86) (inclusive of floodplain); and
(iv) the eastern dunefields (no. of sites = 13), all east of White Crossing.

A quarry at Mulka Hill (Fig. 2) does not fall into any of these areas. The majority of sites in both the western and eastern half of the Lower Cooper (94.23% and 87.88%) consist only of stone artefact scatters but others also contain burials, hearths and quarries. Importantly, a higher proportion of sites containing more than one of these components occurs within the eastern sector, where there is also a higher proportion of sites with evidence for stratification (i.e. 7.78% as compared to 0.96%).

As the artefact population coding in Figs 2 and 3 illustrates, the majority of open surface scatters comprise fewer than 1000 pieces. While intermediate-sized scatters, containing from 1000 to 100 000 pieces, occur both to the west and east of White Crossing, none are recorded west from Warremandoona Waterhole for approximately the 75 km stretch down the Lower Cooper to Lake Eyre. No large scatters, comprising more than 100 000 pieces, are located outside the eastern floodplain zone; i.e. none occur west of White Crossing.

Silcrete quarries were located near Toolerinna Swamp east of Lake Palankarinna, near Etadunna Station and at Mulka Hill (see Fig. 2). These large complexes are all located on gibber outcrops of Tertiary silcrete at the eastern edge of the survey area. The silcrete varies from extremely fine-grained, which appears to have been selectively utilised for the production of unifacial points, geometric microliths and blade endscrapers, to medium to coarse-grained; the latter usually represented in the tula adze, retouched/utilised and 'chopper' categories. Only decortification and low intensity gibber reduction has occurred at the quarries with implement manufacture occurring at other localities. As is common at such sources, the proportions of retouched/utilised pieces and of other lithologies are low; i.e. < 0.5% (*cf.* Clark 1987; Veth 1982). Intensive survey and sampling of the Tertiary silcrete quarries will be undertaken by one of us (G.H.) as part of a postgraduate project starting in 1990 on the Lower Cooper. It is worth noting that stone arrangements occur in the vicinity of the quarries, usually in the form of circular to oval alignments of flaked and thermally fractured silcrete gibber boulders.

Burials and hearths usually occur within site complexes that also contain stone artefacts, only one isolated burial being located. Most lie within major basecamps, usually containing numerous grinding bases, several thousand pieces of flaked stone, and such trade items as ochre and axes, often in stratified contexts. Hearths characteristically contain mixtures of burnt ant bed, charcoal and oxidised sediments.

There are no geological features within the study area that might provide rockshelters or caves with stratified occupation deposits. The only known cave, a mythological site located on a creek draining into Lake Palankarinna (Ditji-mincka) has collapsed and, in any event, would not be an appropriate place to excavate given its continuing religious associations to the Diyari (Hercus 1987).

Preliminary observations on variability in debitage, cores and implements on the Lower Cooper:

Debitage was divided into four mutually exclusive classes based on the hierarchical key proposed by Sullivan and Rozen (1985: 758). The classes are complete flakes, broken flakes, flake fragments and debris. While the characterisation of 'distinct assemblages of debitage' must await detailed sampling of individual sites, it is possible to make several general comments on variation in debitage proportions. Whole and broken flakes (i.e. those with bulbs) are proportionally dominant at major sites within the western section of the Lower Cooper in the silcrete and silicified sandstone categories. Conversely, the proportion of flake fragments and

debris is higher at the larger sites within the eastern zone in the same material categories. Predictably, silcrete decortification flakes appear to make up a higher proportion of debitage assemblages within the eastern floodplain zone, closer to the Tertiary silcrete outcrops.

Mean flake size in both silcrete and silicified mudstone also appears to decrease in the western zone. While blades are found on sites in both zones, almost always in fine-grained silcrete and chert, they represent a much lower proportion of debitage within the western zone. There is a concomitant scarcity of blade cores in the western zone. Of interest is the lack of heavily reduced and exhausted cores in the western zone, given the decreased procurement efficiency here for the silcretes. The highest proportion of such cores is found at what are assumed to be major aggregation sites within the floodplain unit, i.e. those with over 100 000 pieces. Interestingly, larger gibber boulders with only cortex removed were found at sites from near the Birdsville Track to almost the shores of Lake Eyre, although these did represent a greater proportion of cores found at sites in the eastern zone than in the west. A recently deflated cache of such cores was recorded at the major occupation site of Unkumilka, located some 50 km west of the Tertiary silcretes.

A wide range of retouched/utilised flakes occur on the sites which do not conform to the technological criteria for tula adzes, unifacial points, backed pieces and graving implements. These include pieces often referred to in the literature as core scrapers, steep sided scrapers, concave scrapers, notched and denticulate pieces (*cf.* Isaac 1977; Lampert 1981; McCarthy 1976). The differences in morphology of the working edge of the implements is seen to be largely the result of the degree of their reduction and edge rejuvenation and the raw material on which they were manufactured (*cf.* Hiscock 1982; Witter n.d.). A commonly recurring form comprises blades and elongated flakes, distally retouched onto the dorsal surface to produce a medium to steep-angled step and scalar retouched working edge which is convex in plan (Fig. 4, no. 1). Most robust flakes typically show greater variability in edge shape, demonstrating steep angled, step terminated or notched edges (Fig. 4, nos 2–5).

The majority of tulas from the sites are in slug stage, exhibiting some variation in both platform and orientation of retouch to the platform. A number of obliquely truncated slugs suggest that the implements have been consistently applied to the worked material at an angle not parallel to the striking platform (Fig. 4, nos 6–9). Whole tulas were found in some numbers at the major lithic scatters within the floodplain unit. Clusters of between 15 and 35 unutilised tulas, all in medium ground silcrete, were located at three sites and it is likely that these standardised items had been cached and exposed on recently deflated surfaces. Sites with tula clusters are located between 20 to 55 km west from the silcrete supply zone. Most tula flakes and slugs on the open sites have been fashioned from medium-grained silcrete, although a minor proportion occur in chert and chalcedony (Fig. 4, nos 10 and 11).

Backed implements, although never in large numbers, occur at a variety of sites within the eastern floodplain zone. As noted from Central Australian samples (Smith 1988: 90) geometric forms, such as segments, are dominant over non-geometric forms, such as asymmetric and obliquely truncated points (Fig. 5, nos 1–5). Backed implements are predominantly fashioned from fine-grained silcretes, although occasional examples in chert and chalcedony were noted. Unifacial (pirri) points are relatively abundant at some of the larger sites on the floodplain zone. In contrast, they are virtually absent from the western drainage unit. They are almost exclusively fashioned from fine-grained silcretes and display little variation in size attributes, although a few 'notched' specimens were noted. These points, with few exceptions, have had their platforms removed by retouch onto the ventral surface (Fig. 5, nos 6–9). Where the ratio of formal to other retouched/utilised pieces at sites was estimated to be greater than one, there appeared to be an inverse relationship between the proportion of unifacial points and the proportion of tula adzes.

Hafted engraving implements located on the open sites are represented by two formal types, the marni wadna and pirri graver (Fig. 6; 1–2, 3–4) (Kamminga 1985). Only a total of seven specimens (four and three, respectively) were recorded, and these all on larger sites on the eastern floodplain unit. The cross-sections through these archaeological specimens clearly show the different wood gouging profiles; v-shaped versus concave.

Edge-ground axes were recorded from major sites at Unkumilka, Lake Killalpaninna and north-west from Toolerinna Swamp (Fig. 2). All of the axes are symmetrical in section and conform to items traded from the north, as described by McConnell (1976). Two of the axes have had thin sections made and are identified as dolerite, with a petrology identical to that of the Mount Isa axe quarry (McBryde, pers. comm.) (Fig. 7).

As noted, partially flaked silcrete gibber occurs on sites across all geographic zones. Sometimes, when bidirectionally flaked, the boulders have margins with evidence for step fracturing and crushing, suggesting their use as implements. Given the evidence for similar edge damage on cores without microscopic evidence of use-wear

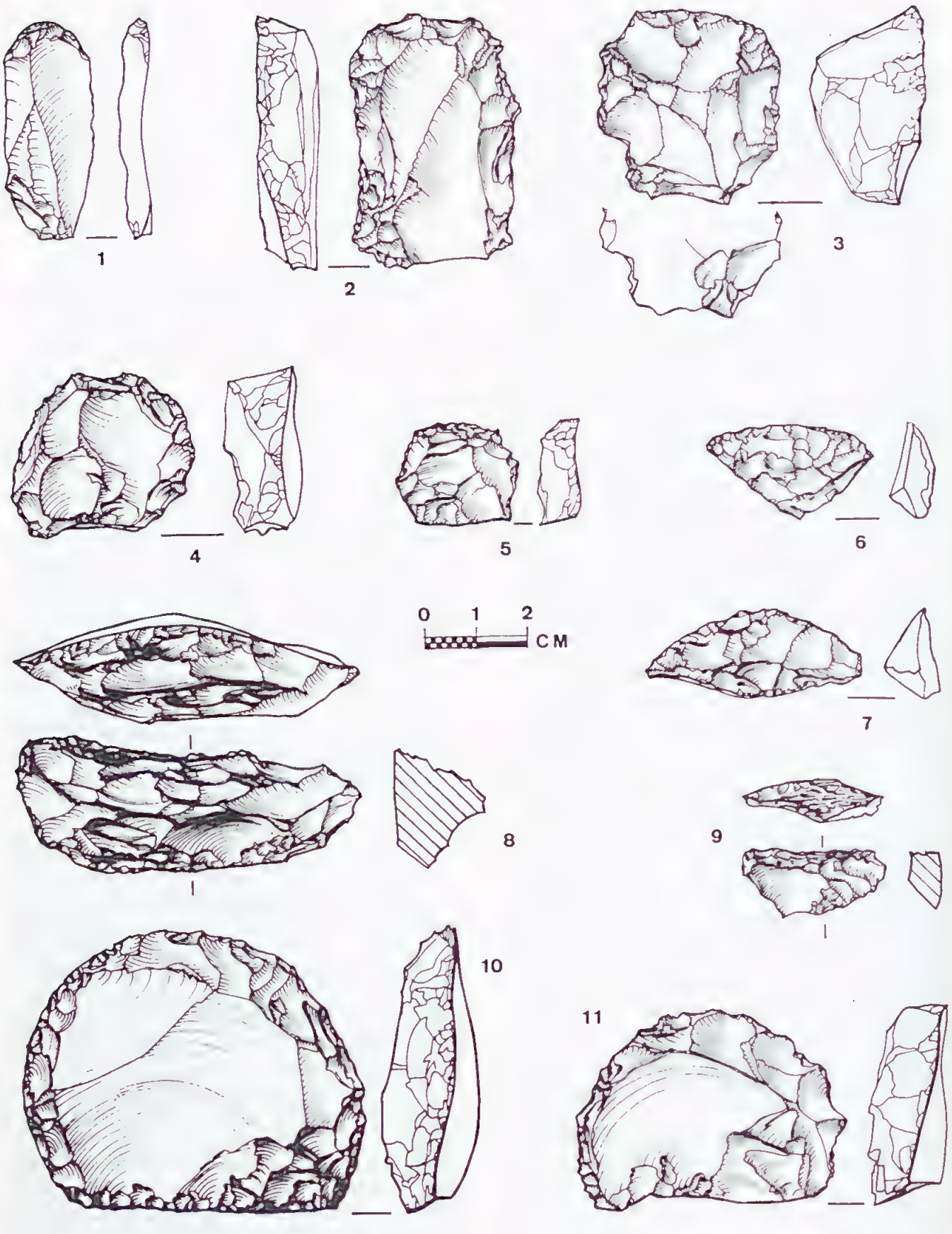

FIGURE 4. 1 Distally retouched blade.
2-5 Retouched utilised flakes.
6-9 Tula adze slugs.
10-11 Tula flakes (Field site nos CC 89, 66, 66, 126, 126, 57, 57, 54, 56, 65, 97).

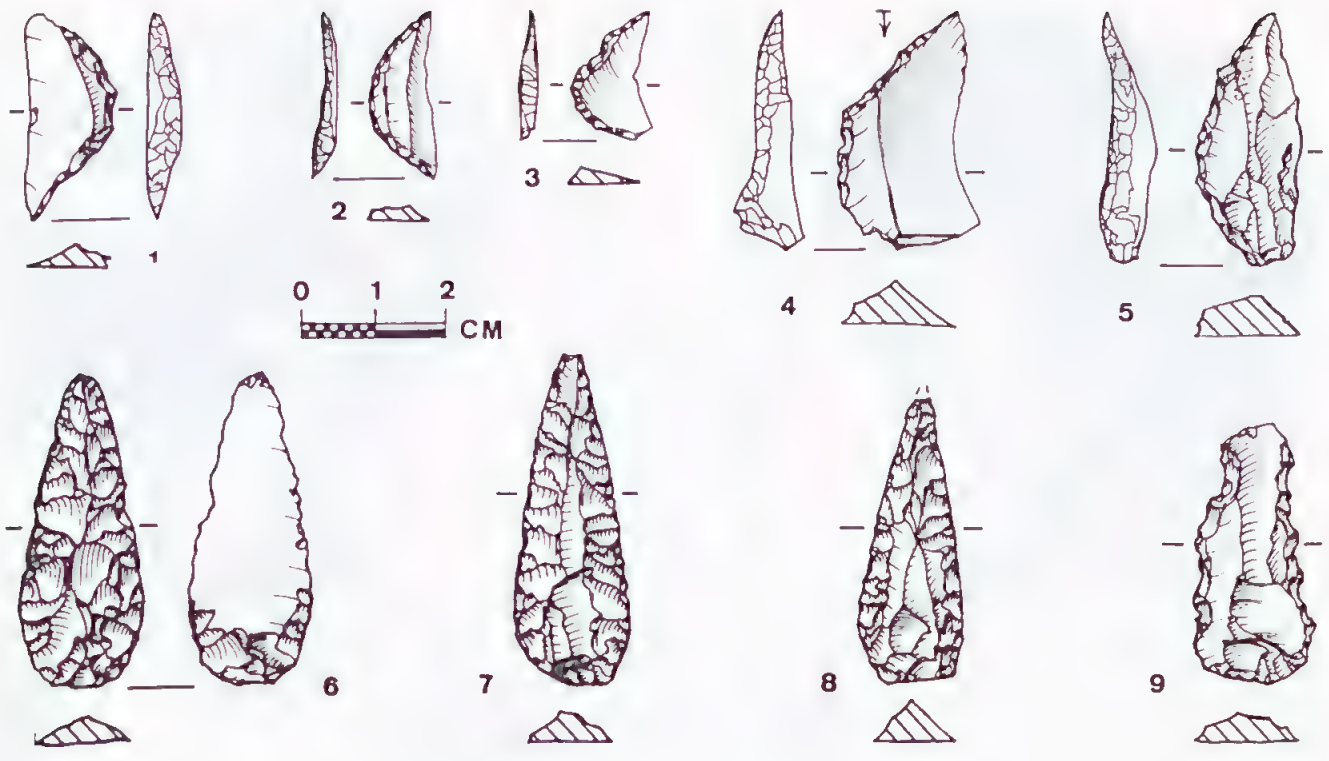

FIGURE 5. 1–5 Backed pieces (segment and point).
6–9 Unifacial points (CC 140, 118, 105, 105, 133, 66, 159, 88, 129).

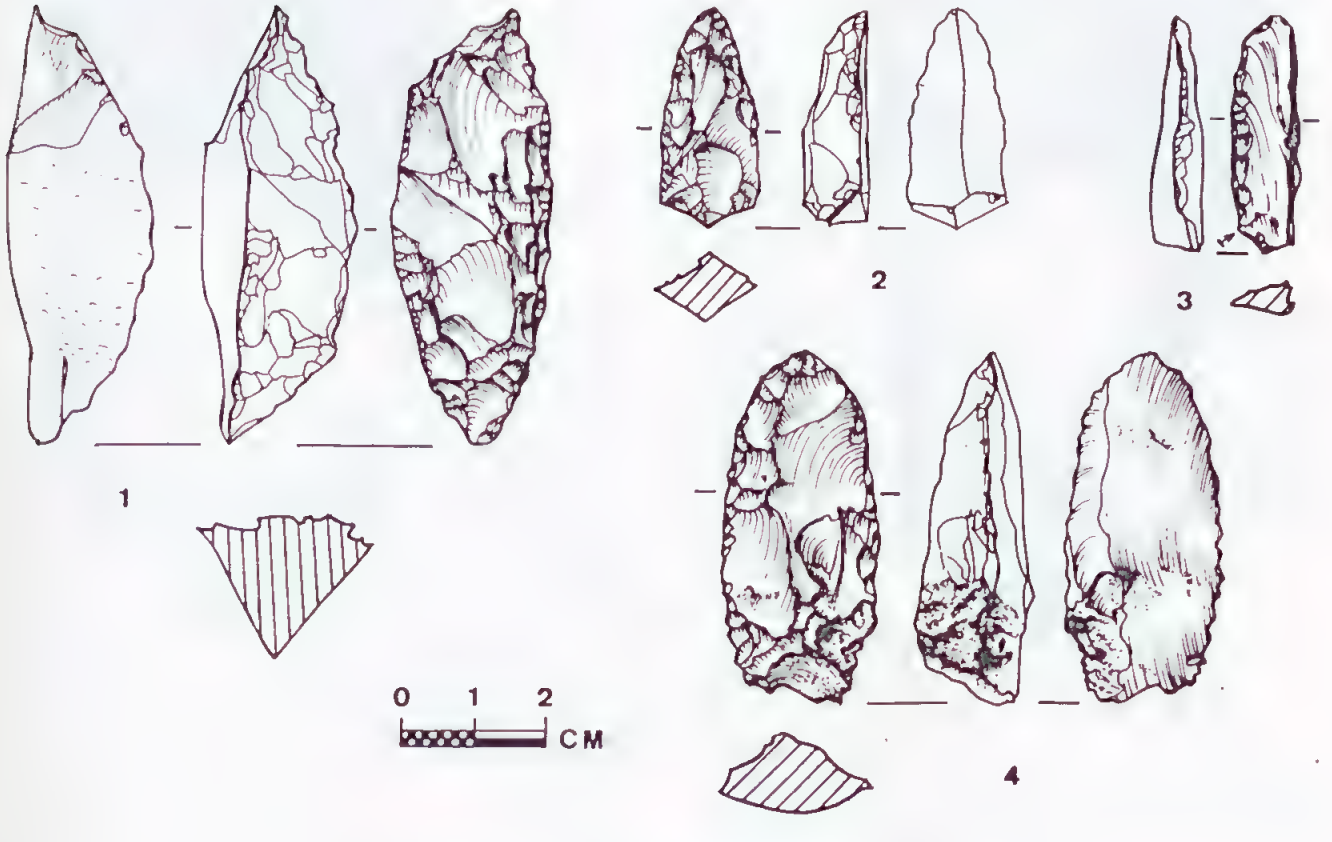

FIGURE 6. 1 Marni wadna.
2 Marni wadna (laterally snapped).
3–4 Pirri gravers (CC 65, 93, 139, 54).

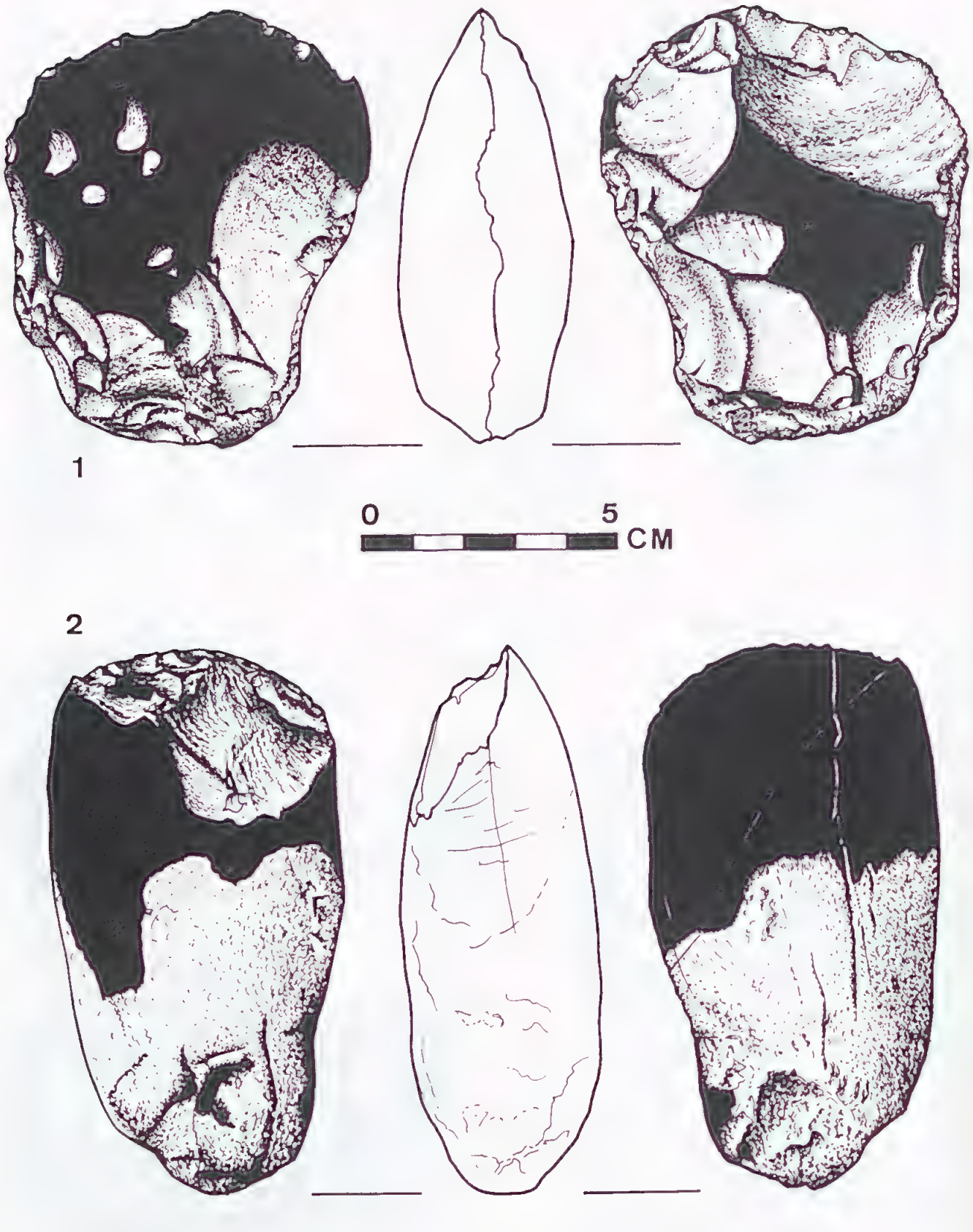

FIGURE 7. 1-2 Edge-ground axes (CC 65, 65).

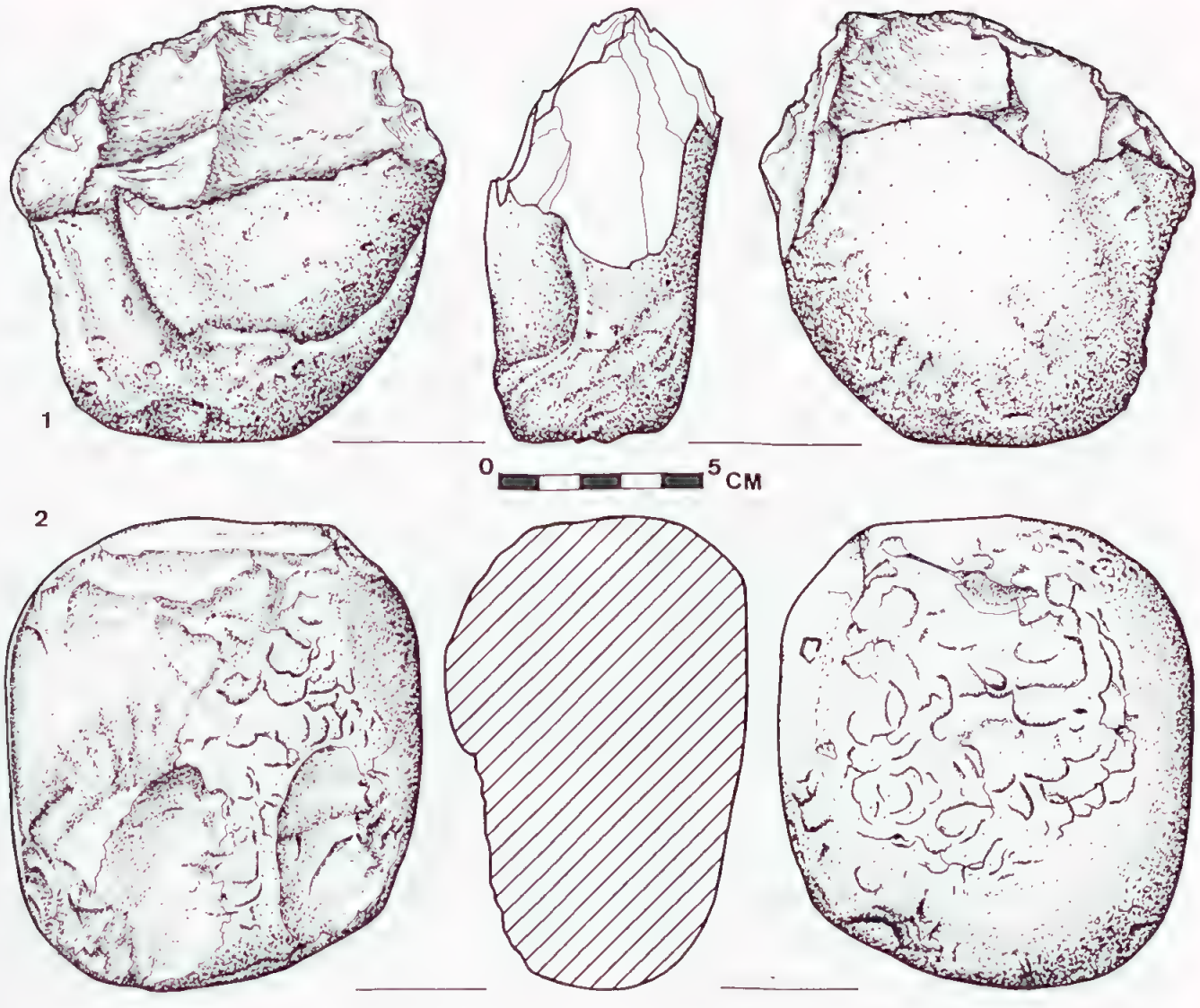

FIGURE 8. 1 Bi-directionally flaked gibber.
2 Pitted/fractured quartzite pebble (CC 68, 115).

(Kamminga 1978: 310–314, 1982: 85–91), however, these are best treated as equivocal implements (Fig. 8, no. 1).

Rounded to sub-rounded quartzite boulders were often located at the major sites or as isolated artefacts, usually near large stands of acacia (e.g. *Acacia salicina)* on the backs of drainage courses. These inevitably have pitting, crushing and fracturing on their opposing faces and extensive crushing on their rounded margins (Fig. 8, no. 2 and Fig. 9, no. 2). These are assumed to be multifunctional items probably serving as preparation platforms for processing seeds and vegetable and animal foods, for grinding ochre, for implement manufacture and also as hammerstones. (*cf.* Smith 1988: 98).

Several cylindrical-sectioned quartzite 'pestles' were also recorded, all with crushing on opposing ends (Fig. 9, no. 3). One heavily weathered cylcon (*cf.* Hamm 1987) manufactured from calcareous sandstone was recorded from a site located 1 km north of Unkumilka Waterhole (Fig. 9, no. 1). Finally millstones, fragments of these and mullers (after Smith 1986) were located from sites within all zones. Significant differences in the number and in the lithology of these millstones were noted, however, between environmental zones on the Lower Cooper (see below).

Testing the Archaeological Predictions of the Proposed Settlement/Subsistence Model

Preliminary assemblage data recorded during the survey allows a number of archaeological predictions to be addressed here.

Prediction 1:

Mean assemblage population and artefact density will be significantly higher within the eastern flood-

plain unit of the survey area in comparison with the western unit. Figures for the floodplain sites will be significantly larger than those recorded from sites within the adjacent dunefields, while those from the drainage line of the western half and adjacent dunes will be of a similar order.

The null hypothesis that assemblage population and artefact density will be the same between floodplain and drainage zones is rejected. Mean number of artefacts for the floodplain sites (N = 86) is substantially greater at 25 464 pieces compared with 339 pieces (N = 101) for the western drainage sites. These differences are significant at an alpha level of 0.05 ($t = -2.383$, $p = .0182$). Mean density of artefacts, expressed here as square metres per single artefact, is also significantly higher at 12 m^2 artefact for the floodplain sites compared with 45 m^2 artefact for the western drainage zone ($t = 2.743$, $p = .0067$). Mean assemblage populations are not significantly different from the drainage units in comparison to sites from the adjacent dunefields ($t = .843$, $p = .4013$ and $t = .412$, $p = .6809$). Interestingly, the density of artefacts from the floodplain sites is significantly higher than that of adjacent dunefield sites ($t = -2.659$, $p = .0092$) while the density of artefacts from the western drainage sites is statistically similar to that of the adjacent dunefields ($t = .212$, $p = .8328$).

There is general support for the notion of larger and more dense sites being associated with the floodplain unit of the Lower Cooper in comparison with the drainage unit, west of White Crossing. There is limited support for homogeneity of lithic scatters located on the western drainage line and adjacent dunefields and for differences in scatters located within the floodplain unit and adjacent dunefields.

Prediction 2:

Mean site density, per survey unit area, will be significantly higher within the floodplain unit in comparison with the western drainage unit.

An area of approximately 45 km^2 was actually surveyed within the eastern floodplain unit as compared to 120 km^2 in the western drainage unit, giving site densities of 1.91/km^2 versus 0.92/km^2. Site density on the floodplain unit, therefore, is double that on the western section. The arguably greater productivity of the floodplain unit receives further support. Further survey work is required within the dunefields before comparisons of site density between these and the riverine 'conduits' can be made.

Prediction 3:

Lithic diversity will be higher in sites within the eastern section in comparison to the western section and both will have higher values than the dunefield sites.

A comparison of the proportional distribution of sites with varying numbers of lithic materials between the different environmental units is presented in Table 2. There is a clear trend towards fewer sites with four, or more, raw material types with movement west from the floodplain unit down the Lower Cooper. The lower lithic diversity of the dunefield sites is evident in that 86% have three, or fewer, raw materials present. A breakdown of the proportional distribution of different stone materials found at sites within the different environmental units is given in Table 3. Interestingly, there are few major differences in the proportions of raw material utilised between the riverine units or between these and adjacent dunefield sites. The decreasing proportion of silcrete, the dominant raw material, with movement west and the increasing reliance on some alternative materials can be explained simply in terms of the decreasing procurement efficiency of silcrete. Silicified mudstone appears to be only found in significant quantities at open sites within a 5 km radius of the large local quarry at White Crossing.

Prediction 4:

The mean number of whole seed-grinding bases per site will be significantly higher for the eastern section in comparison to the western section and both will have similar values to sites in adjacent dunefields.

The mean number of basal grinding stones per site is significantly higher for the floodplain unit in comparison to the western drainage unit; i.e. 10.79 versus 0.29 ($t = -3.046$, $p = .0027$). Prediction 1 demonstrated that the floodplain sites had

TABLE 2. Proportion of sites with different numbers of stone raw materials for environmental units.

	No. sites	No. of stone material types								
		1	2	3	4	5	6	7	8	9
Eastern floodplain unit	86	14	20	28	23	9	3	0	1	2
Western drainage unit	101	17	33	28	17	2	3	0	0	0
Dunefield units	16	48	23	15	7	7	0	0	0	0

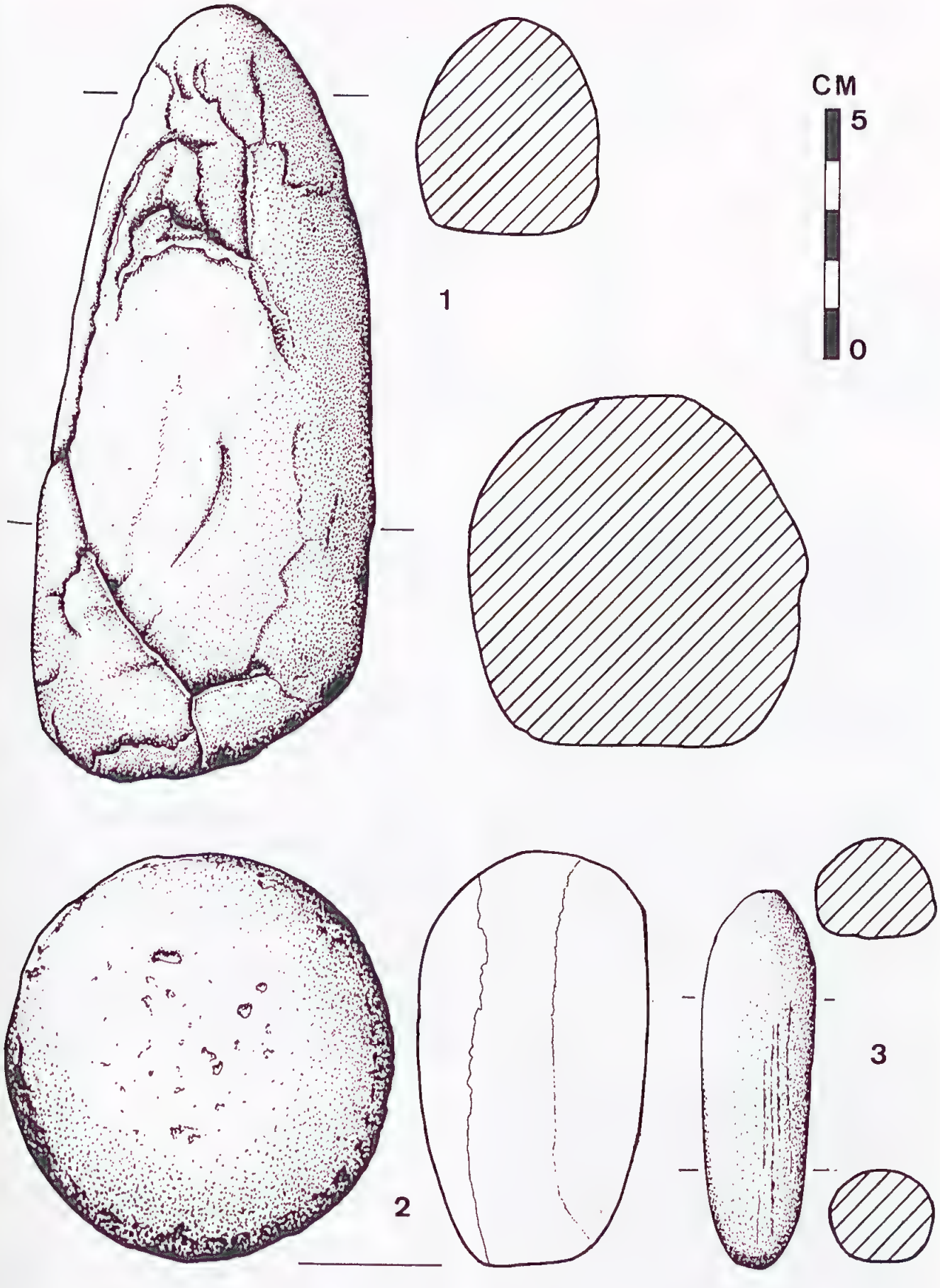

FIGURE 9. 1 Cylcon.
2 Pitted/edge-abraded quartzite pebble.
3 Pestle (CC 134, 54, 151).

TABLE 3. Proportion of different stone materials comprising assemblages between environmental units.

	Eastern floodplain unit	Eastern dunes	Western drainage unit	Western dunes
No. of sites	86	13	101	3
		% different raw materials		
Silcrete	88	96	86	92
Chert	1	2	3	1
Chalcedony	0.50	0.39	3.00	3.00
Red/brown Sandstone	0.39	0.15	0.10	0.00
Ferruginised Sandstone	0.30	0.23	0.12	0.00
White Sandstone	0.87	0.38	0.95	0.00
Silicified Mudstone	7.94	0.77	6.19	4.00
Quartzite	1.00	0.08	0.64	0.00

significantly larger artefact populations, however, and when the ratio of basal grinding stones to other flaked artefacts within assemblages is compared, the relative differences appear much smaller; i.e. 1:1172 versus 1:2359. There is no significant difference in the mean number of grinding bases between the floodplain unit and adjacent dunefield ($t = .789$, $p = .4322$). No grinding bases were recorded from the (small) sample of three sites in the western dune unit.

Prediction 5:

The proportion of formal implements to other retouched/utilised items will be higher in the floodplain unit than in the western drainage unit.

The proportion of formal implements to other retouched/utilised items was, on field estimates, divided into four categories: Nil, 0-33%, 34-66% and > 67%. Formal implements, here, include tula adzes (and slugs), unifacial points, backed segments and asymmetrical points, pirri gravers, the marni wadna and edge-ground axes. The breakdown of sites for these categories between the eastern and western sections is given in Table 4. There is a substantially greater number of sites without formal implements in the western drainage unit in comparison to the eastern floodplain unit (34.62%, N = 36 versus 2.02%, N = 2). The noticeably reduced proportion of morphologically and/or technologically standardised implements at sites on the western section of the Lower Cooper is of interest as it probably relates to real differences in manufacture, curation and discard behaviour. This is seen to occur in a more environmentally homogeneous land system which lacks alternative stone supplies.

TABLE 4. Proportion of sites in different formal/non-formal implement categories.

	Proportion of formal to non formal implements				
	Nil	0-33%	34-66%	>66%	No. Sites
Eastern units	2.02	80.81	15.15	2.02	99
Western units	34.62	60.58	1.92	2.88	104

Prediction 6:

Trade goods such as ochre, exotic seed-grinding bases, edge-ground axes, mussel shell fragments and cylcons will be more numerous on assumed aggregation and redistribution sites within the eastern section in comparison to sites of the western section.

The number of different categories of trade items represented at sites was tabulated and the sites are subsequently divided as those with one or less categories of trade items and those with more than one. These tabulations are presented in Table 5.

TABLE 5. Proportion of sites with trade items between western and eastern section.

	No. of trade categories	
	≤ 1	> 1
Eastern floodplain unit	70 (70.70%)	29 (29.30%)
Western drainage unit	94 (90.38%)	10 (9.62%)

There is clearly a higher proportion of sites with one, or more, categories of trade items within the

eastern floodplain unit, and this is significant at the .05 level (chi = 12.389, p = .0004). A general trend was noted in this unit that the sites which had the largest number of trade categories and the largest number of trade items were also the sites with the largest lithic scatters, the highest proportions of grinding material, the greatest diversity of lithic materials, the highest ratios of formal to non-formal implements and were those containing the most spatially discrete activity areas. Although the major sites recorded so far lie to the west of the major trade and exchange route documented to the east of Lake Eyre (McBryde 1989), it is significant that they are part of the same floodplain land system. They are suggested, here, to have served as major aggregation and redistribution points within the floodplain unit. In terms of their size and material complexity they are distinct from any sites located west from White Crossing to Lake Eyre.

The suggestion that the eastern floodplain unit, and specifically the ecotone between it and the dunefields, would provide archaeological evidence for the most complex and varied economic and social behaviour finds general support from an examination of preliminary assemblage data along the Lower Cooper Creek. Significant differences are noted between sites in the eastern and western units in respect of debitage assemblages, assemblage size and density, site density, diversity of lithic materials, proportion of formal implements and number of trade items. Greater homogeneity was noted between sites on the western drainage unit and adjacent dunes in comparison to the floodplain unit and its adjacent dunefield.

We argue that homogeneity of sites in the western section, collectively, reflects a 'dunefield adaptation' in which the function (*cf.* Binford 1980) of sites varies little across drainage and dunefield units. In contrast, there is consistent variation in sites between the eastern floodplain unit and adjacent dunefields and this is argued to reflect differences in seasonality and duration of site occupation, group size and residential mobility between these units. This is seen to reflect a 'riverine-tethered' adaptation.

Dated Hearth Features

Two shallow depressions, saucer-shaped in profile and containing charred wood and burnt ant-bed material, are almost certainly hearths, though further investigation is needed to verify this beyond doubt. They are clearly in situ within calcreted dune cores located 5 km apart along the Lower Cooper (Field numbers CC77 and CC139; H1 and H2 in Fig. 2). Both are surrounded by artefacts lying on deflationary surfaces and at H2, artefacts appear to be within, and eroding from, the same horizon as the hearth. At each site the hearth itself was excavated to examine its relationship with the calcreted sediment unit, to test its vertical development and to gather charcoal from its burnt and consolidated matrix for radiocarbon dating. The dates obtained are shown in Table 6.

TABLE 6. Radiocarbon dates from charcoal in hearths (H1 and H2, Fig. 2).

Sample No.	Field Site No.	Quantity	Conv. Age (yrs BP)	New Age (yrs BP)
Wk-1509	CC77 (H1)	18 g	11,830±320	12,180±330
Wk-1510	CC139 (H2)	12.6 g	11,770±180	12,110±190

Both hearths have late Pleistocene dates which statistically overlap at one standard deviation. With stratified artefacts appearing both at hearth level and in more recent horizons, field site CC139 has the potential to yield cultural assemblages spanning the terminal Pleistocene/early Holocene period, which is poorly represented in the present population of excavated arid zone sites (*cf.* Smith 1988).

As noted above, the other major site with clearly stratified cultural material, at Unkumilka Waterhole (CC65; infilled circle in Fig. 2), is likely to yield cultural material from the mid- to late Holocene period. Both flaked and ground artefacts, as well as at least two burials, were noted to be within, and eroding from, vertical sections of the weakly indurated sediments of a leeside dune series. In combination, this site and CC139 have the potential, through excavation, to yield dateable cultural assemblages spanning the terminal Pleistocene to the contact period.

Conclusion

Systematic archaeological survey of the Lower Cooper Creek has revealed probable evidence for human occupation by approximately 12 000 B.P. and a possible efflorescence in the numbers of sites which can be assigned to the late Holocene, witnessed in the extraordinarily rich record of sites containing Small Tool components. That such an increase in assumed late Holocene occupation may be related to different factors such as regional changes in hydrology, more intensive use of existing resources, [e.g. the advent of hafted woodworking implements and formal grindstones (*cf.* Smith 1988; Veth 1989b)], intensified social relations (Lourandos 1985), exponential population growth

following colonisation (*cf.* Beaton 1985), or simply differential site preservation must await excavation and dating of the stratified sites and geomorphological work on both source-bordering and linear dunes. This is likely to include thermoluminescence dating of various dune series.

Significant differences in site densities and assemblage structure noted between the environmentally finer-grained and expansive floodplain unit and the sinuous drainage unit, west to Lake Eyre, are argued to reflect real variations in Holocene settlement/subsistence strategies. This analytical division was based on hydrological, botanical and emic criteria.

The Lower Cooper is argued to have excellent research potential at a number of levels. Broader questions relating to the timing of colonisation and nature of human adaptation in the dunefield habitats of Sahul's pulsating arid core during the late Quaternary may be addressed, given the unique suites of fluviatile and aeolian sediments associated with the Lower Cooper's modern drainage course. Stratified open sites potentially spanning the terminal Pleistocene to Contact, through excavation, may provide data on local technological industries, general economic behaviour within the floodplain unit and address the issue of intensity of occupation through time. The presence of numerous trade goods, particularly at major sites within the floodplain unit, suggests that these loci (lying outside the major trade routes) have acted as places for secondary exchange and/or redistribution. Detailed analysis of these assumed 'aggregation' sites and comparison of assemblage structure and reduction strategies with satellite occupation sites is likely to illuminate the relationships between social organisation and resource distribution. Given that there are well-defined stone supply zones, particularly for the silcretes, the Lower Cooper provides an ideal natural transect to examine both trade in stone materials as well as behavioural phenomena such as rationing, discard criteria and use of alternative materials.

For a wide range of interrelated theoretical and methodological issues, the Lower Cooper provides an optimum focus for future problem-oriented archaeological work.

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REVIEW

Dreamings: The Art of Aboriginal Australia edited by P.J. Sutton, with contributions by Peter Sutton, Christopher Anderson, Philip Jones, Francoise Dussart, Steven Hemming. Viking, published in association with the Asia Society Galleries, New York, 1988. 266pp., 260 numbered figs (155 in colour). Hardback $A65.00, paperbound $A35.00. Reviewed together with the exhibition 'Dreamings. The Art of Aboriginal Australia', organised by the Asia Society Galleries, New York and the South Australian Museum.

The exhibition *Dreamings*, organized by the South Australian Museum and the Asia Society in New York, will probably be remembered for having amplified white Australia's 'discovery' (after 200 years) of Aboriginal art, and broadcast it to the United States. Although not the first exported exhibition of Aboriginal art, it has been the most significant historically, because of its size and quality, and because of various factors which made the timing ideal. The exhibition reflected a major resurgence in Aboriginal painting, and coincided with a period of strong overseas interest in Australia.

The exhibition will become an important marker in the cultural history of Australia. The book which accompanies the exhibition however will continue to live not just in the memory, but in the active discourse of people who concern themselves with how we should go about understanding Aboriginal culture in general.

First and foremost the book *Dreamings* is a record of the exhibition, which was on the whole very well received when it opened in New York. This is particularly impressive considering it is nothing like a knock-down-drag-out block-buster, although it includes many objects of great beauty and rarity. It would have been easier to cater to several romantic notions of Aboriginal Australia. For example the organisers could have offered an exhibition about a mysterious ancient race of artists creating earthy, but spiritual objects out of wood, bark and ochre; or alternatively, untutored modern masters producing an extravagant feast of big, visually powerful Western Desert paintings. Instead a great amount of work and thought was put into constructing a view of Aboriginal Australia which conveys problematic complexity rather than dramatic unity.

Dreamings is not the kind of exhibition which saturates the viewer with a sense of familiarity and understanding of one particular kind of art. It leaves the viewer still asking questions, most of which can be answered by the book. The publication *Dreamings* is large, extensively illustrated with images from the exhibition or relevant to it, and contains material for three different books; one about the history and development of Aboriginal art, one about how to interpret and respond to various Aboriginal artforms, and one tracing the way non-Aboriginal interpretation of the art has evolved. It is essential to the character of this book, however, that these (and other) seemingly disparate strands of study are combined and often closely interwoven. As Peter Sutton, curator of the exhibition and the book's editor, explains on page 14 of the book:

> A central message of this book is that while the literal meanings, the visual devices, the aesthetic potential and the social-contextual significance of Aboriginal art may each be distinguished in theory, they all interact in practice to constitute the total meanings of the works for Aborigines. Those who seek an understanding of the art need to approach it on all fronts.

The book carefully satisfies several needs in the field of literature on Aboriginal art, and avoids covering ground which has been covered already. Certain artefacts (for example shields) are given detailed discussion in terms of meaning or history without actually explaining what they were for, while elsewhere the social uses of paintings are dealt with. Artefacts which cannot be discussed in terms of iconography are excluded. With its subject matter and this fresh approach the book naturally reads as a highly innovatory study. The methodologies of the social historian, the economist and the political scientist come into play from time to time, enhancing the more conventional tactics of study. The surprising combinations of illustrations reflect the unconventional approach. Across one double-page spread, painting on aluminium is juxtaposed with painting on bark and painting on canvas (but in this case the canvas of a pair of sandshoes). The three chapters by Peter Sutton are a detailed lesson in 'reading' Aboriginal art, objectively explaining terms which have acquired a misleading sentimental mythology in white Australian culture and using diagrams to explore individual works. The chapter by Christopher Anderson and Francoise Dussart provides a much-needed, substantial introduction to the Western Desert paintings which have attracted such a blinding flurry of popular interest over the past several years. The historiography of Aboriginal art contributed by Philip Jones provides a necessary reminder that ideas change, and gives a context into which we can fit the current interpretations which the book offers. The last chapter by Sutton, Jones and Steven Hemming explains the responses of Aboriginal art to the imported culture and society which has threatened it.

Implicit in the stance taken by this book is an argument against the preconceived distinction between art and anthropology which has for so long distorted the way Aboriginal art has been viewed. This comes at a time when the figure most influential (indirectly) on contemporary art writing is an anthropologist, the late Claude Levi-Strauss. The need for a structured understanding of the social and intellectual context of artists in the intelligent study of what has conventionally been called art, and the importance of a visual response in the field of anthropology have made it increasingly difficult for any specialist to claim an artefact (or art object) for his or her particular discipline. This book demonstrates that it is our ways of looking at and thinking about Aboriginal art that need to be redefined, for the exhibition has demonstrated that the objects themselves exist splendidly independent of ways in which viewers may wish to categorize them. The thoroughness of scholarship and care in looking at works which *Dreamings* combines is an example to everyone who writes about material culture, whether as an art critic/historian or anthropologist.

T. MORRELL, Director, The College Gallery, South Australian College of Advanced Education, Holbrooks Road, Underdale, South Australia 5032. *Rec. S. Aust. Mus.* 24(1): 67-68, 1990.

THE AURUKUN PROJECT

Over the past five years the Division of Anthropology of the South Australian Museum has hosted a research project focused on Aboriginal relationships with the land in western Cape York Peninsula. Most of the land in this case lies within the Aurukun Shire.

Peter Sutton, manager of the project, has worked in the Cape York Peninsula region as an anthropologist and linguist over a period of twenty years. Detailed cultural landscape mapping has been a major feature of this work. This involves visiting the homelands of Aboriginal people whose intimate knowledge of local geography, mythology, history and natual history is recorded, usually on site. Analysis of these systems of knowledge is integrated with adjoined studies of local languages, social structure, religion, politics, and social change, for example. This research has been funded by the Australian Institute of Aboriginal Studies, Aurukun Shire Council and Aurukun Community Incorporated (both using Department of Aboriginal Affairs funds), the Australian Research Council, the Australian Heritage Commission, and the South Australian Museum.

Since the mid 1980s Dr Roger Cribb has been employed from time to time to collaborate on the integration of this detailed information in a computer database. He has also carried out archaeological survey work in the region, and has assisted with ethnographic site recording. Together with David Martin of the Australian National University, who has very extensive research experience of the same region, he recently worked with Peter Sutton to produce a report combining the western Cape York Peninsula Aboriginal site data of several researchers, including that of von Sturmer, Sutton, Martin, Cribb and Chase. The November 1989 draft of this report, which covers a narrow coastal strip between the Embley and Edward Rivers, contained 2085 site records and spanned 1050 pages.

The immediate rationale for the production of this particular version of the data was that the Aurukun clan leaders had requested supporting evidence for their opposition to seismic survey work in their area by the mining company Comalco. Comalco wished to bulldoze seismic lines over much of the Shire in its search for oil, and the traditional landowners appealed to the Federal Minister for Aboriginal Affairs to make an emergency declaration of the Shire as a significant area under the 1984 Aboriginal and Torres Strait Islander Heritage Protection Act as amended. At the time of writing Comalco has suspended its exploration activity and has not announced its exploration intentions for the 1990 dry season. No emergency declaration has been made, but preparation of the relevant documentation is proceeding nonetheless.

There is another reason for the construction of this database in the complex form it has now taken. It can produce map graphics as well as tabulated versions and reworkings of the various site records and their many fields, and is a fully-fledged if rather mechanical research tool in the field of people-land ecological and socio-cultural relationships.

In essence, the academic dimension of the project aims to marry the rich insights of a cultural anthropological perspective with the quantification and systematic detail made possible by a very large and powerful machine-readable body of observations and statements. A great deal is now known, for example, about the particular knowledge system that in this region traditionally integrated social and political groupings, religious symbolism, land ownership, the demographic pattern, landforms, vegetation zones, seasonality and economic resources. Using the project's database it is now possible to quantify, for example, the relationship between site density, site type, and vegetation or landform zone.

The database manager, IBM PC-FOCUS, thus allows us to test for statistically significant degrees of spatial association or segregation between kinds of places. We can quantify degrees of association between cultural and physical properties of sites and the ecological zones (Aboriginal- or scientist-defined) in which they occur. We can provide a precise test for the hypothesis that clan estates tend to be so constructed as to maximise their ecological diversity, or that cremation mounds and ritually dangerous places are closely associated with clan estate boundaries. The vitally important cultural categories of clan totemism, local cult ceremonies, environmental 'nickname' groupings and broad regional political groupings, all well understood from social anthropological studies of the last 15 years, can now be given far greater definition at the level of their geographical content. And we can now provide the kind of hard data on so-called ethnographic sites that is of direct relevance to the work of archaeologists.

Complemented by rich interpretative material linking the sites together under historical, religious, political and other local cultural perspectives, and by a detailed ethnobotanical study carried out by Peter Sutton and ecologist Dermot Smyth in 1978–9, linked to a micro-level vegetation zone survey by Smyth, this study is now ready for a major publication.

There is probably no other region of Australia that has been so thoroughly researched in this way, although the work of Neville White and his

associates in eastern Arnhem Land, albeit with a different focus, is probably the nearest parallel. It is unlikely that a project of similar depth, detail, length and expense will ever be replicated in Australia, if only because of the loss of intimate traditional landscape knowledge among Aboriginal people. Without publication, however, the considerable impact of in-depth studies such as this cannot be realised.

The theoretical significance of this work is at two main levels: that of generalisations about Australian Aboriginal land relationships, and that of the broader issue of the relationship between cultures and the environments in which they are reproduced. Our essential theoretical contribution in this context has been to integrate the analysis of land relations with the shifting dynamics of political life rather than to present them as if they were a relatively static and self-contained backdrop to action.

At a broader level, this study will seek to build on contemporary anthropological theory, with its phenomenological strengths, while avoiding the extreme subjectivist stance under which all forms of knowledge appear to belong to the same phenomenal order. Formal or systemic knowledge, for example, does not have the same epistemological status as conscious and substantive knowledge, and is culturally constituted in a different way. I look at this issue by focusing on the constitution of Aboriginal geographical knowledge. Perhaps definable as 'neo-objectivist', my approach is also to try to improve the theoretical status of the notion of evidence in the anthropological enterprise. The operational metatheories of many current anthropological paradigms rest overmuch on criteria such as internal coherence and completeness of scope, and insufficiently on those such as degrees of testability and degrees of fit with the available ethnography. My critique of this kind of theoretical value-system arises in part out of the problem of describing how Aboriginal environmental knowledge is related to Aboriginal environmental experience.

In most of Cape York Peninsula an era of relative stability has followed the initial catastrophic impact of colonisation. That era may soon be at an end. The region has suddenly become a focus of attention by major development interests, conservation groups, and governments charged with responsibility not only for tourism and other infrastructure but also for major aspects of Aboriginal welfare. Proposed and planned developments, including a commercial space base, a large tourist resort at Iron Range, the sealing of the Peninsula road, sand mining, gas and oil exploration, and many other new activities, are ominous signs as far as the Aboriginal population is concerned, since Aborigines are still the region's majority, constituting two-thirds of all people in the Peninsula. If this balance is radically shifted in favour of non-Aboriginal outsiders, experience elsewhere suggests that further social and cultural decline and disintegration will occur among the Aborigines.

This project has had very keen support from the Aurukun Aboriginal people, who have at times raised their own funds to assist its field programme, and who hold a key interest in the data. The clan leaders in 1985 gave their support in principle to the proposal for a publication containing this representation of their knowledge, pending final consultation over contents. They are deeply concerned that their land-based traditions be recognised and respected by a wider public.

P.J. SUTTON, Research Associate, Anthropology Division, South Australian Museum, North Terrace, Adelaide, South Australia 5000. *Rec. S. Aust. Mus.* 24(1): 69–70, 1990.

CERORIBATULA GEN. NOV., *FOVORIBATULA* GEN. NOV. AND FOVORIBATULINAE SF. NOV. (ACARIDA: CRYPTOSTIGMATA: ORIBATULIDAE) FROM SOUTH AUSTRALIAN SOILS

D. C. LEE & C. M. BIRCHBY

LEE, D. C. & BIRCHBY, C. M., 1991. *Ceroribatula* gen. nov., *Fovoribatula* gen. nov. and Fovoribatulinae sf. nov. (Acarida: Cryptostigmata: Oribatulidae) from South Australian soils. *Rec. S. Aust. Mus.* **24** (2): 71–89.

Ceroribatula gen. nov. (including two species-complexes) and *Fovoribatula* gen. nov. are established, with seven new species as follows: *Ceroribatula incrustata*-complex, *C. incrustata* (type-species), *C. bizygata, C. monozygata, C. trirostrata; C. megaforamina*-complex, *C. megaforamina; Fovoribatula brevisetosa* (type-species), *F. mesosetosa.* They are grouped in the Fovoribatulinae, a new subfamily in the Oribatulidae, with four other genera. The new species are from plant litter, moss or soil at the four drier (arid, semi-arid, mallee-broombush, mallee-heath) sites of the nine florally diverse South Australian sites sampled. Four species carry a conspicuous cerotegument, which in *C. incrustata* forms patches of thick wax. The leg chaetotaxy of the Oripodoidea is briefly discussed and the absence of setae on femora I and II is given taxonomic significance. There is a key to adults of Australian species of Fovoribatulinae.

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This is a further part of an ongoing study of sarcoptiform mites in South Australian soils, sampled from nine florally diverse sites, and for which an introduction to the relevant work on the advanced oribate mites (Planofissurae) has been published (Lee 1987). The mites considered here have been referred to as 'seven species of *Oribatula*-like mites' in the publication describing *Decoribatula* Lee & Birchby, 1989. They are grouped here in two new genera. With *Brassiella* Balogh, 1970, *Decoribatula*, *Reticuloppia* Balogh & Mahunka, 1966 and *Romanobates* Feider, Vasiliu & Călugăr, 1970, they make up the Fovoribatulinae, a new subfamily within the Oribatulidae Thor, 1929.

The Fovoribatulinae has a deficient chaetotaxy on femora I and II, which is unusual amongst the Oripodoidea. This has had some consideration with the description of *Decoribatula* Lee & Birchby, 1989, but is further commented on here. Also the sejugal apodeme notation and the terms used to describe sculpturing of the integument are briefly reconsidered.

The notum is illustrated for all seven species, but the idiosterna are so similar for some pairs of species that they are only illustrated for four species. The only complete set of legs illustrated is for *Ceroribatula incrustata* (Fig. 4), where, because of the variations in leg chaetotaxy, the setae are drawn on femora I and II. Some legs are illustrated for a further four species, mainly to represent the variations in chaetotaxy on femora I and II, but also the relative sizes of the tarsi and pretarsal claws. Measurements are in micrometres (μm). The mites examined were all collected by one of us (D.C.L.) and are mainly deposited in the South Australian Museum (SAMA), but also in the Natural History Museum, London (BMNH), the Field Museum of Natural History, Chicago (FMNH) and the New Zealand Arthropod Collection, DSIR, Auckland (NZAC).

Notation and Leg Chaetotaxy

The modifications in morphological notation presented in papers on *Setobates* (Lee & Pajak 1988) and *Scheloribates* (Lee & Pajak in press) are followed here, but elaborations are made in defining apodemes and describing the integumental sculpturing, whilst the relevent leg chaetotaxy is discussed.

Three types of apodemes are associated with the sejugal somal division: *dorsosejugal apodeme* (= dorsophragmatic apophysis of Norton 1983); *pleurosejugal apodeme* (= bothridial apodeme of Lee 1987, which merges dorsally with the integument near the bothridium of sensory seta *z*2); *ventrosejugal apodeme* (= sejugal apodeme of the podosternum). Also, two further thickenings in the podosternal integument, other than apodemes I, II and III associated with the coxites, are apparent in the largest species (*C. trirostrata,* Fig. 9), *midsternal apodeme* dorsal to seta *III*1, and the *postpodal apodeme* abaxial to seta *IV*2 (not homologous with

apodeme IV, which is absent in the mites considered here).

It is characteristic of Fovoribatulinae that the integument is sculptured and incrusted with a substantial and sometimes conspicuous cerotegument. The sculpturing often consists of many small pits, each in the centre of a shallow depression. The depression may be circular or, if bounded by reticulate ridges, hexagonal. The reticulate ridges probably consist partly of the cerotegument (the superficial layer of the integument developed by exudation through pores in the cuticle), since they are conspicuous and more raised around the patches of thick wax on *Ceroribatula incrustata* (Fig. 3). The thick wax is columnar, white and strongly refractile, the hexagonal columns growing out at right angles to the integument surface, both in this species and *Reticuloppia reticulata* Balogh & Mahunka, 1966. On the other hand, the wax may form a thinner layer, uniformly covering the integument, and sometimes containing small, refractile wax granules making it either generally dirty white in colour as on *Ceroribatula bizygata* or forming white patches as on *Ceroribatula trirostrata* and *Fovoribatula mesosetosa.* The microsculpturing varies, the different states merging into a continuum, but they are categorized as follows: *foveate,* pitted; *reticulate-foveate,* pitted, with each pit in a hexagonal space delineated by reticulate ridges; *reticulate,* reticulate lines or ridges without pits; *alveolate,* depressions that may be separated by indistinct reticulation.

The chaetotaxy of five setae on both femora I and II is the same for most members of the Oripodoidea. Using only the four major files of setae on a leg segment (see Lee 1981, fig. 19), this chaetotaxy is represented by the number of setae that are *anterior, dorsal/ventral, posterior* and is given as follows: I - 0,2/2,1; II - 0,2/2,1. Exceptionally some setae are absent, either just the posterior seta as in Symbioribatidae Aoki, 1966 and a few genera of Oripodidae Jacot, 1925, or always the distoventral seta (*v*2) on femur II and some other ventral or posterior setae on femora I and II, as in Lamellareidae Balogh, 1972, Crassoribatulinae Balogh & Balogh, 1984, and the genera grouped here in the Fovoribatulinae sf. nov. The absence of such setae, at least within the latter two subfamilies of Oribatulidae, is considered primitive because they are also absent in the Licneremaeoidea, regarded as the most primitive group within the Poronota and a sister group to the Oripodoidea. But it should be noted that the Galumnoidea, regarded as the most derived superfamily within the Poronota, always lacks seta *v*2 on femur II.

The relevant femoral chaetotaxy in the Oribatulidae has a number of forms when it is deficient as in the Fovoribatulinae and Crassoribatulinae. These are listed, with the most deficient first, as follows:

I - 0,2/1,0; II - 0,2/1,0 some *Ceroribatula*
I - 0,2/2,0; II - 0,2/1,0 some *Ceroribatula* and *Reticuloppia*
I - 0,2/1,1; II - 0,2/0,1 *Brassiella*
I - 0,2/1,1; II - 0,2/1,1 *Fovoribatula* and *Decoribatula*
I - 0,2/2,1; II - 0,2/1,1 *Romanobates* and *Crassoribatula.*

The chaetotaxy of *Brassiella* and *Crassoribatula* is not given in the literature, but is newly recorded here after examining the holotypes of *Brassiella penicillifer* Hammer, 1973 and *Crassoribatula maculosa* Hammer, 1967. Not all variations are reflected in the above presentation of chaetotaxy, for example, in *Fovoribatula* the ventral seta on femur I is distoventral (*v*2 - see Fig. 13), whilst in *Decoribatula* it is proximoventral (*v*1 - see Lee & Birchby 1989, fig. 2). Also illustrations sometimes suggest a different setal position because of the orientation of leg segments, as for femur I of *Ceroribatula monozygata* (Fig. 5), where *v*1 appears to be in position *p*1. Such possibilities for confusion are greater when the greatest number of setae are absent compared with the usual complement for the Oripodoidea, since the seta present may be located in an intermediate position between its usual place and the expected position of the absent seta. In previous papers on the Planofissurae by one of us (e.g. Lee 1987) only a seta 'v' has been shown on femur II, in order to indicate its relationship to a ventral flange that is sometimes present; more specifically this is seta *v*2.

Systematics

Subfamily **FOVORIBATULINAE** sf. nov.

Nominotype genus: *Fovoribatula* gen. nov.

Diagnosis

Oribatulidae. Hysteronotum with 14 pairs of short, medium length or long setae. Translamella either absent, lineate or costate; if laminar it is confined to the lateral part and not present across midline. Lateral proteronotal foramen (*f*1) small but clearly multiporose. Sensory seta (*z*2) clavate with subglobose caput. Integument usually with extensive foveate and/or reticulate sculpturing, often with substantial cerotegument, sometimes forming thick, white, refractile, columnar wax. Anterior margin of hysteronotum either convex with dorsosejugal furrow curving around lenticulus or truncated with straight dorsosejugal furrow and no lenticulus. Femur II with fewer than normal five setae, at least seta *v*2 absent (0, 2/1, 1). Legs slim, medium length or long, leg IV (femur-tarsus)

usually longest, sometimes subequal in length to leg I.

General Morphology and Character State Polarization

On the basis of the absence of femoral setae, both Fovoribatulinae and Crassoribatulinae are regarded as a primitive group within the Oribatulidae (see section on 'Notation and Leg Chaetotaxy'). The Oribatulidae in turn is regarded as a primitive family within the Oripodoidea because of its multiporose hysteronotal foramina and a lack of pteromorphs. The Fovoribatulinae is, therefore, recognised by the absence of derived character states. The Crassoribatulinae, which also lacks seta *v*2 on femur II, is distinguishable from the Fovoribatulinae by three derived character states: ten pairs of hysteronotal setae, six pairs of genital setae and a midsternal gap in the ventrosejugal apodeme.

The classification established here for genera within the Fovoribatulinae is based on the premise of a polarization of the increasing number of setae on femur I and II being more derived. There are considered to be two lineages, a primitive one in which there is no posterior seta on femur II, including *Ceroribatula* and *Reticuloppia,* and a derived lineage in which this posterior seta is present. On the basis of this, the similarities between *Reticuloppia* and *Decoribatula,* although due to derived characters (long hysteronotal setae and divided hysteronotal foramen *F*3), are convergent. The same is true for *Ceroribatula megaforamina* and *Fovoribatula mesosetosa.*

On the basis of this polarization, the states of other possibly important characters are polarized as follows. The seta *sl* on the proteronotum, seta *v* on trochanter I and the hysteronotal setae are regarded as primitive if they are shorter and as derived if they are longer. For the proteronotal ridges, the presence of weakly laminar, complete lamellae or the presence of one or two translamellae (as *Ceroribatula bizygata,* Fig. 6) is considered to be primitive, whilst the absence of lamellae and translamellae (as *Reticuloppia reticulata* Balogh & Mahunka, 1966) is considered derived. For the hysteronotum, the presence of a lenticulus associated with a mid-dorsal, forward pointing protruberance and an undivided anterior multiporose foramen (*F*3) is regarded as primitive, whilst a straight anterior hysteronotal margin with no lenticulus and a divided anterior multiporose foramen (*F*3*a* and *F*3*b*), as for *Decoribatula pustulosa,* is derived. For the pretarsal claws, relatively short (*cf.* tarsus) claws with slim lateral claws (Fig. 4, leg II) is regarded as primitive, whilst long claws with stout lateral claws (Fig. 12) is derived.

Distribution

The Fovoribatulinae appears to be endemic to the Oriental and Australasian Regions. Within these regions it has not yet been found in cooler temperate southern Australia and New Zealand. This is based on few data, but from the South Australian sampling, *Ceroribatula* and *Fovoribatula* are represented by seven species (substantial species diversity) which are confined to the four drier, hotter sites. The previous records are of *Brassiella* from Ceylon, New Guinea, Samoa, New Caledonia and Tonga, *Decoribatula* from Singapore, *Reticuloppia* from tropical Queensland and *Romanobates* from southern Roumania. This suggests that the relevant faunas of the mallee and arid regions are derived from tropical faunas either as relicts from tertiary tropical climates in the region or as invaders from recent tropical climates to the north. As viewed here, the most primitive species occur in the mallee and arid region faunas, suggesting that they are the relicts.

Remarks

The Fovoribatulinae includes oribatulid genera that have a lack of certain femoral setae, and compared with the oribatulid Crassoribatulinae with a similar lack of setae, they have fewer genital setae, an entire rather than an incomplete ventrosejugal apodeme, and more hysteronotal setae. These latter three character states they share with Oribatulinae. The Fovoribatulinae are very different from the Lamellareidae, which also has a primitive lack of the same femoral setae. Without the recognition of the reduced chaetotaxy, members of a particular fovoribatuline group would be included in the Oribatulinae with species in either *Oribatula* Berlese, 1895 or *Zygoribatula* Berlese, 1916. There has, therefore, been a considerable reweighting of the importance of particular characters. The relationships between the six included genera, as presented here based on the femoral chaetotaxy, places them in two sister-groups: the primitive *Ceroribatula* and *Reticuloppia,* and the derived *Brassiella, Decoribatula, Fovoribatula* and *Romanobates.* On the other hand, *Ceroribatula* is superficially most similar to *Fovoribatula.*

The nature and possible adaptive significance of the incrustation can only be given preliminary consideration. What is probably a similar incrustation is described on the humeral hysteronotal region of *Oribatula exudans* Travé, 1961, but it is a homogeneous wax and not made up of columns. Wax blooms, although not so substantial, have also been described on an *Oppia* species (Brody 1970). The temporary presence of wax filaments making an arid region tenebrionid beetle white rather than black has been observed

as an adaption to control water loss (Louw & Seely 1982). This possible relevance of wax incrustations to water conservation could be true for *Reticuloppia* and *Ceroribatula,* but it is also possible that it is an excretory product.

The following six genera are included in the Fovoribatulinae: *Brassiella* Balogh, 1970, *Ceroribatula* gen. nov., *Decoribatula* Lee & Birchby, 1989, *Fovoribatula* gen. nov., *Reticuloppia* Balogh & Mahunka, 1966 and *Romanobates* Feider, Vasiliu & Călugăr, 1970. A key is provided for the eight Australian species included in the subfamily.

Key To Australian Fovoribatulinae (Adults)

1 — Hysteronotal setae longer than distance between their bases. Lamella absent or incomplete, not reaching bothridium to seta *z*2, which is turret-like (height subequal to diameter of pore). Five pairs of hysteronotal multiporose foramina..... ....*Reticuloppia reticulata* Balogh & Mahunka
— Hysteronotal setae shorter than distance between their bases. Lamella present, reaching bothridium to seta *z*2, which has low profile (height less than 0.5× diameter of pore). Four pairs of hysteronotal multiporose foramina.....2

2 — Femora I and II lack posterior setae (Fig. 4). Pretarsal claws smaller, central claw less than 0.3× length of tarsus II....*Ceroribatula* gen. nov., 3
— Femora I and II with a posterior seta (Fig. 13). Pretarsal claws larger, central claw greater than 0.3× length of tarsus III..... .....*Fovoribatula* gen. nov., 7

3 — Long proteronotal seta *s*l (subequal to distance *j*2 - *z*1, Fig. 10) and trochanter I seta *v* (able to reach seta *v*2 on femur I)..*C. megaforamina* sp. nov.
— Short proteronotal seta *s*l (0.6× or less distance *j*2 - *z*1, Fig. 1) and trochanter I seta *v* (only able to reach seta *v*l on femur I or shorter).....4

4 — Femur I with seta *v*2 present (Fig. 4). Translamella present or absent.....5
— Femur I without seta *v*2 (Fig. 5). Translamella present.....6

5 — Translamella absent. Rostrum without incisions. Hysteronotal foramen *F*3 with longitudinal axis less than 2× breadth (Fig. 1).*C. incrustata* sp. nov.
— Translamella present. Rostrum divided by two incisions into three points. Hysteronotal foramen *F*3 with longitudinal axis more than 3× breadth (Fig. 8).....*C. trirostrata* sp. nov.

6 — No ridge between proteronotal setae *j*2–*j*2. Setae *j*2 and *z*1 ciliate and clavate (Fig. 7). Mid-sternal and hysteronotal integumental sculpturing foveolate.....*C. monozygata* sp. nov.
— Lamella-like ridge present between proteronotal setae *j*2–*j*2. Setae *j*2 and *z*1 smooth and lorate (Fig. 6). Midsternal and hysteronotal integumental sculpturing reticulate.....*C. bizygata* sp. nov.

7 — Translamella present. Hysteronotal setae short (*J*2 length less than 0.5× distance from setal base *J*3) (Fig. 14). Lateral pretarsal claws depth more than 0.5× depth of central claw (Fig. 12)..... .....*F. brevisetosa* sp. nov.
— Translamella absent. Hysteronotal setae medium length (*J*2 length 0.5–1.0× distance from setal base *J*3) (Fig. 16). Lateral pretarsal claws depth less than 0.5× depth of central claw (Fig. 13)..... .....*F. mesosetosa* sp. nov.

Genus ***Ceroribatula*** gen. nov.

Type-species: *Ceroribatula incrustata* sp. nov.

Diagnosis

Fovoribatulinae. Hysteronotal setae short or medium-length (shorter than distance between their bases). Lenticulus present, associated with mid-dorsal forward pointing protruberance of hysteronotum. Lamellae present, laminar and complete (between *z*1–*z*2). Translamella present (may be second costate ridge) or absent. Rim of bothridium (base of seta *z*2) low, not turret-like. Four pairs of hysteronotal multiporose foramina. Discidium present as costate ridge. Femora I and II without posterior setae usually three setae (0, 2/1, 0) but femur I may have four setae (0, 2/2, 0). Pretarsal claws short (central claw II less than 0.3x length of tarsus II).

Remarks

Ceroribatula is superficially similar to *Fovoribatula* gen. nov., but it is regarded as more closely allied to *Reticuloppia* Lee & Birchby, 1989, because of the chaetotaxy on femora I and II. The name is derived from the Latin '*cera*' meaning wax, as used in the term 'cerotegument'. The cerotegument is sometimes particularly conspicuous and comprises contiguous merged vertical columns of wax as on *C. incrustata* (also is present on *Reticuloppia*). The genus includes two species-complexes: the *incrustata*-complex and *megaforamina*-complex.

incrustata-complex

Diagnosis

Ceroribatula. Hysteronotal setae (shorter than 0.5× distance between bases), proteronotal seta *s*l (shorter than diameter of bothridial aperture) and trochanter I seta *v* (shorter than distance between setae *I*1–*I*2) short. Translamella present or absent. Femur I either with (0,2/2,0) or without (0,2/1,0) seta *v*2.

Remarks

The *incrustata*-complex is regarded as the more primitive group within *Ceroribatula,* having some species with only three setae on femora I and II and short somal (except for proteronotal setae *j*1, *j*2 and *z*1) and trochanter I setae. It is diverse, comprising four new species as follow: *C. incrustata* (type-species), *C. bizygata, C. monozygata, C. trirostrata.*

Ceroribatula incrustata sp. nov.
Figs 1–4

Female

Dorsal profile of hysteronotum subcircular, colour dark brown, cerotegument substantial posteriorly and pleurally around legs, white incrustation of wax always on proteronotum, rarely on hysteronotal humeral region (Fig. 3), sometimes on venter of femora I and II. Idiosomal length, 468 (mallee-heath, n = 9, 406–504) and 497 (mallee-broombush, n = 3, 488–509). Leg lengths (femur-tarsus for idiosomal length 488, mallee-heath): I – 239, II – 224, III – 222, IV – 270. Tibial maximum heights (for 488): I – 26, II – 18, III – 18, IV – 16.

Proteronotum with weakly laminar lamellae and costate sublamellae, translamella absent. Seta *j*2 shorter (less than 0.75×) than *z*1, both ciliate, and clavate, cerotegument may increase size of caput. Dorsolateral aspect illustration (Fig. 3) represents the right seta *j*2 as shorter due to parallax. Conspicuous cerotegument anterior to seta *z*1 is undivided (Fig. 3) or may be bilobar, with the lateral subhexagonal wax columns being longer and curving outwards. Posterior to thick cerotegument, integument conspicuously reticulate-foveate and may have small vertical tubercles at angles of hexagons, and no incrustation further back where integument foveate or weakly alveolate with well-spaced circular shallow depressions. Lamella usually carries highly refractive segmented strip of cerotegument. Sensory seta *z*2 clavate with globose caput and many fine pointed cilia, smaller and more numerous than represented (Figs 1 and 3).

Hysteronotal setae subequal in length, with two longitudinal distal files of cilia (usually only one file visible when viewed from above). Lenticulus smooth, pale, surrounding integument weakly alveolate, further laterally cerotegument conspicuous, either reticulate-foveate or forming columns in places (Fig. 3), posterodorsally mainly foveate. Multiporose foramina subequal in size and oval, position of *F*5 and *F*6 usually as illustrated (Fig. 1), sometimes closer to mid-line, when *F*5 on adaxial side of seta *S*5.

Podosternum with circumpedal ridge merged with rest of subpedal ridge, extending to weak custodial ridge fading just anterior to pedotectum II. Two adaxial setae on coxite I similar in length (*1*1 and *1*2 subequal). Central region with foveolate sculpturing similar to that illustrated (Fig. 2) around posterior margin of genital orifice.

Opisthosternum with setae of fairly uniform length, *Sa*1 subequal to *Sa*3. Adanal pore *Saf* nearly longitudinal, further from anal orifice than its length. Eggs oval, 170 × 75 (mean of 11 horizontally aligned eggs, 40% of mean female length), smooth or wrinkled exochorion. Number of eggs in female (number of females) as follows: four (2), six (2), eight (5).

Legs medium-length (mean femur-tarsus: 49% of soma), slim (mean maximum tibial height: 30% of mean length). Dorsal porose areas and weak alveolate abaxial sculpturing, usually with reticulate cerotegument on all femora and trochanters III and IV. Only three setae on femur II (0,2/1,0) and four setae on femur I (0,2/1,0).

Male

As for female except genital orifice not or only narrowly abutting onto ventrosejugal apodeme. White proteronotal incrustation present on 16 of 20 males ex mallee-heath and all 5 males ex mallee-broombush. Soma smaller, idiosomal length 425 (mallee-heath, n = 20, 398–475) and 429 (mallee-broombush, n = 5, 416–445).

Material Examined

Holotype: ♀ (N1989164), sand, litter, under banksia shrubs (*Banksia ornata*), Tamboore Homestead (35°57′S, 140°29′E), 4.viii.1974.

Paratypes: 6♀♀ (N1989165–N1989169), 16♂♂ (N1989170–N1989183); 1♀, 2♂♂ – BMNH; 1♀, 2♂♂ – FMNH; 1♀, 2♂♂ – NZAC; same data as holotype.

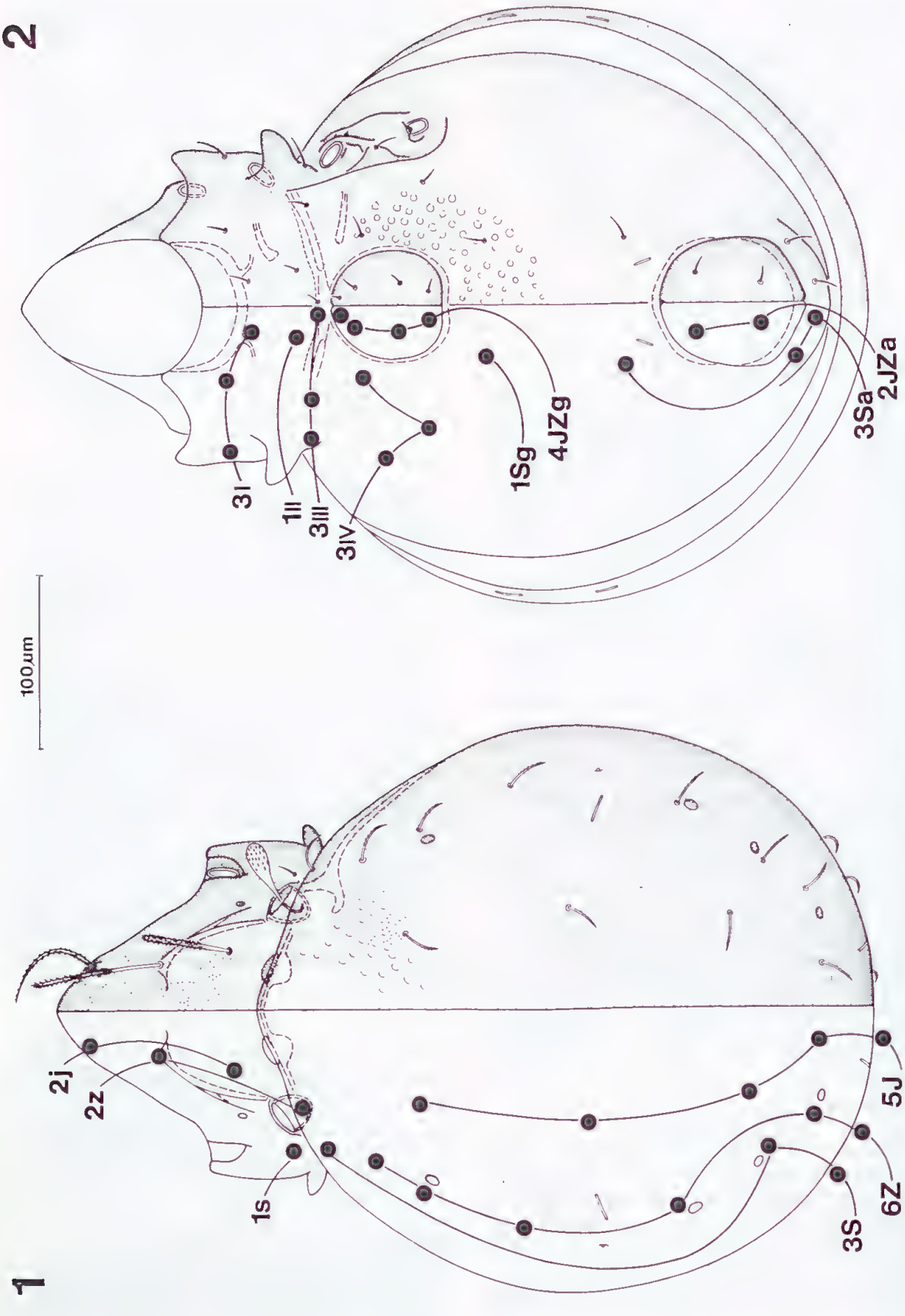
Undesignated: 3♀♀ (N1989184–N1989186), 5♂♂ (N1989187–N1989191), sand, litter, sparse moss, under ridge-fruited mallee (*Eucalyptus incrassata*) amongst broombush shrubs (*Melaleuca uncinata*), Ferries-McDonald Reserve (35°15′S, 139°09′E), 20.vi.1974.

Distribution

Australia (Aa), South Australia. Mallee-broombush, open scrubland (Ferries-McDonald Reserve), Murray-Darling basin, 3♀♀, 5♂♂ / 4 of 8 × 25cm^2. Mallee-heath, tall open shrubland (Tamboore Homestead, near Mt Rescue Conservation Park), Murray-Darling basin, 9♀♀, 20♂♂ / 6 of 8 × 25cm^2.

Remarks

Ceroribatula incrustata is the type-species of the genus and the species-complex. The name is derived from the Latin '*incrustatio*' meaning 'crust' or 'hard coating', referring to the wax incrustation often



FIGURES 1 and 2. *Ceroribatula incrustata* sp. nov., female soma. 1, notum without incrustation; 2, idiosternum.

FIGURE 3. *Ceroribatula incrustata* sp. nov., female anterior soma, dorsolateral aspect showing proteronotal and hysteronotal incrustation of wax.

present on the proteronotum and sometimes on the humeral region of the hysteronotum (Fig. 3). The hysteronotum is circular in horizontal aspect, but otherwise specimens without an incrustation are similar to *C. monozygata*, because of the size and the form of the notal setae. On the other hand, the presence of a distoventral seta (*v*2) on femur I means that *C. incrustata* is similar to *C. trirostrata* in its chaetotaxy. The wax incrustation, hysteronotal shape and femoral chaetotaxy are similar to those of *Reticuloppia reticulata* Balogh & Mahunka, 1966, and this is regarded as reflecting a close relationship between these genera, as opposed to what are regarded as convergent similarities between *Ceroribatula* and *Fovoribatula*.

Ceroribatula bizygata sp. nov.
Fig. 6

Female

Dorsal profile of hysteronotum ovoid, colour dark brown, cerotegument forms continuous notal (except over lenticulus) and pleural layer, substantial thickness (greater than diameter of setal bases) including abutting refractile wax granules and vegetable detritus, giving translucent dirty white appearance and obscuring setae. Idiosomal length 617 (n = 2, 609–625). Leg lengths (femur-tarsus for 625): I – 319, II – 301, III – 280, IV – 334. Tibial maximum heights (for 625): I – 31, II – 26, III – 21, IV – 21.

Proteronotum with costate translamella, laminar lamellae, costate sublamellae (not merging anteriorly with lamellae). Seta *j*2 shorter (about 0.75×) than *z*1, both hyaline and lorate, weakly ciliate (not illustrated in Fig. 6). Integument mainly weakly reticulate. Costate ridge between setae *z*2–*j*2–*j*2–*z*2 appearing as second 'translamella'. Short curved subtutorium. Sensory seta *z*2 with globose caput, smooth, without cilia.

Hysteronotal setae subequal in length, lorate, weakly ciliate distally (not illustrated in Fig. 6), rank 5 (*J*5, *Z*5, *S*5) curved upwards. Anterior margin extends forward to lie close to seta *j*2. Lenticulus smooth, pale, otherwise integument with reticulate sculpturing. Anterior foramen (*F*3) as illustrated (Fig. 6) or may encompass adaxial margin of *Z*2 setal base and be attenuated anteriorly, posterior foramina (*F*4, *F*5, *F*6) less than 0.5× size of *F*3. Pore to hysteronotal gland *(hGf)* opens into refractile sac.

Podosternum with deep cavity behind acetabulum IV, forms circumpedal ridge level with seta *IV*2, which does not merge with discidial ridge so subpedal ridge not continuous (i.e. as *C. trirostrata,* Fig. 9, not as *C. incrustata,* Fig. 2). Setae on coxite I differ in size, *I*1 0.5× *I*2. Integument reticulate.

Opisthosternum with setae of differing form and lengths: *JZg, Sg* and *JZa* short and setose (similar to *C. incrustata,* Fig. 2); *Sa*1 lanceolate, length about 0.33× distance *JZa*1–*JZa*2; *Sa*2 and *Sa*3 lorate, similar to hysteronotal setae, length subequal to distance *JZa*1–*JZa*2. Most of integument reticulate, genital shield smooth, anal shield mainly reticulate-foveate, just foveate near lateral margins. Eggs subcylindrical with convex ends, 202 × 79 (mean of 7 horizontally aligned eggs, 32% of mean female length), smooth exochorion. Number of eggs in female (number of females) as follows: four (1), six (1).

Legs medium-length (mean femur-tarsus: 49% soma), slim (mean maximum tibial height: 30% of mean length). Dorsal porose areas and strong reticulate abaxial sculpturing on all femora and trochanters III and IV. Only 3 setae on femora I and II (0–2/1–0).

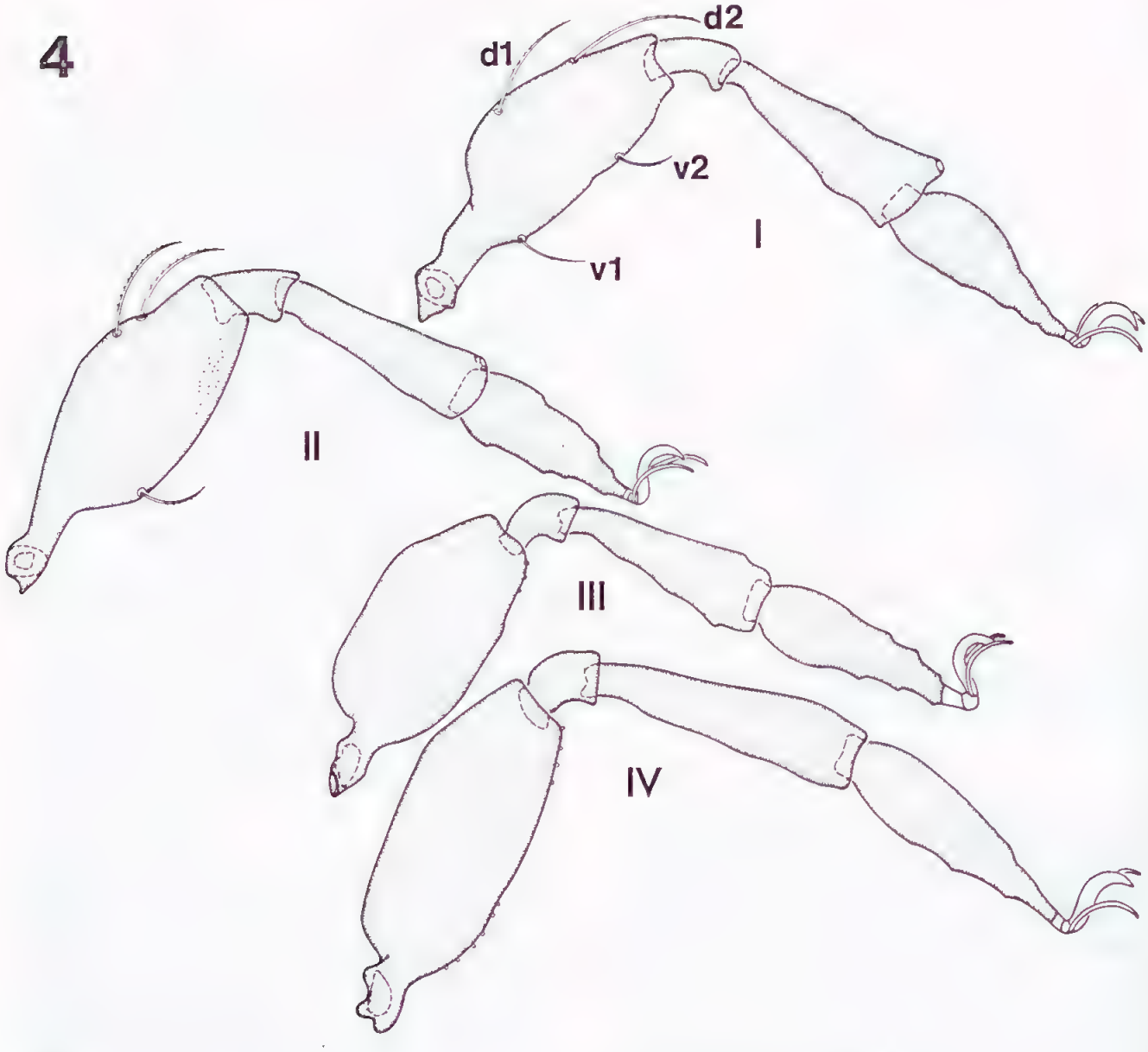
Male

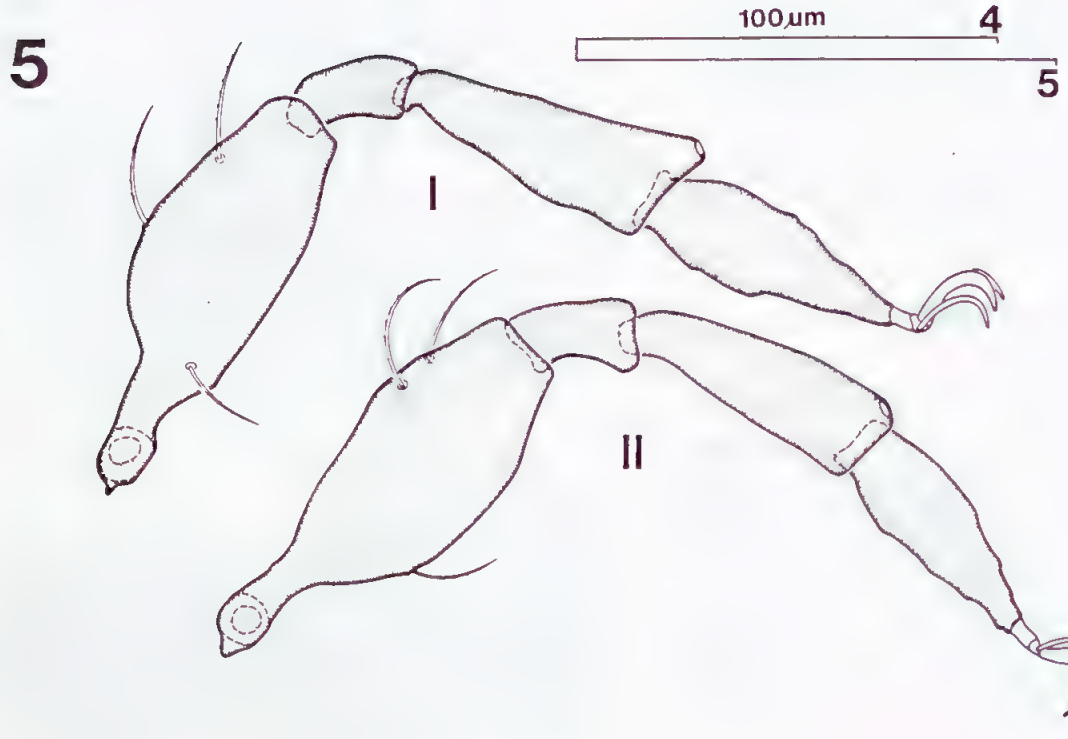
Unknown

Material examined

Holotype: ♀ (N1989192), soil, litter, moss and other low growth plants under bladder saltbush (*Atriplex vesicaria*) amongst sparse false sandlewood (*Myoporum platycarpum*), Koonamore Vegetation Reserve (32°07′S, 139°21′E), 27.vi.1974.

Paratype: 1 ♀ (N1989193) same data as holotype.


4
d2
d1
v2
v1
I
II
III
IV


5
100µm
4
5
I
II

Distribution

Australia (Aa), South Australia. Semi-arid low shrubland (Koonamore Vegetation Reserve), Lake Eyre Basin, 2 ♀♀ / 2 of 8 × 25cm^2.

Remarks

Ceroribatula bizygata is regarded, along with *C. monozygata,* as the most primitive species in the genus, having the lowest number of femoral setae. It is the second largest species, and is strongly sclerotized, with the result that some characters are clear, but the thick dirty cerotegument and weakly refractile lorate setae make the chaetotaxy difficult to assess. The prefix of its name is derived from the Latin '*bis*' meaning '*two*', whilst the rest is based on the Greek '*zygon*' meaning 'yoke' or 'pair', referring to the translamella as in *Zygoribatula* Berlese, 1916 (Oribatulidae), and so to the presence of a second 'translamella', i.e. the costate ridge between the lamellae and setae *j*2–*j*2.

Ceroribatula monozygata sp. nov.
Figs 5 and 7

Female

Dorsal profile of hysteronotum ovoid, usually brown with some straw coloured specimens regarded as teneral, cerotegument forms continuous notal (except over lenticulus) and pleural layer, thin, foveate indentations matching those of integument, either hyaline or finely granulate, some attached plant detritus, but little effect on mite's appearance. Idiosomal length 495 (semi-arid shrubland, n = 6, 465–519); 530 (arid grassland, n = 1); 454 (mallee-heath, n = 3, 425–482). Leg lengths (femur-tarsus for idiosomal length 493, semi-arid shrubland): I – 225, II – 220, III – 208, IV – 272. Tibial maximum heights (for 493): I – 23, II – 21, III – 18, IV – 17.

Proteronotum with translamella costate across midline but laminar laterally, weakly laminar lamellae, sublamellae costate, merging anteriorly with lamella. Setae *j*2 and *z*1 subequal in length, both refractile and clavate, conspicuously ciliate. Integument weakly foveate around rostrum, otherwise smooth. Indistinct line near seta *j*2. No subtutorium. Sensory seta *z*2 with globose caput, covered in minute cilia.

Hysteronotal setae subequal in length, setose, ciliate distally. Lenticulus smooth, pale, otherwise integument foveate. Anterior foramen (*F*3) as illustrated (Fig. 7) or may abut onto posterior margin of *Z*2 setal base, posterior foramina (*F*4, *F*5, *F*6) subequal in size to *F*3.

Podosternum with circumpedal ridge merging with discidial ridge to form a continuous subpedal ridge weakening anteriorly, similar to *C. incrustata* (Fig. 2). Coxite setae in ranks 1 and 2 similar in size to each other and longer than on *C. incrustata.* Integument with reticulate sculpturing anteriorly, on coxite IV small alveoles.

Opisthosternal setae in file *S* similar in size, setae on genital and anal shields (*JZg, JZa*) slightly smaller. Most of integument with foveate sculpturing, anterior zone of smaller pits more extensive than on *C. incrustata* (Fig. 2), genital shield smooth. Eggs oval, 188 × 85 (mean of 5 horizontally aligned eggs, 33% of mean female length), smooth exochorion. Number of eggs in female (number of females) as follows: none (2), one (1), two (1), four (1), eleven (1).

Legs medium length (mean femur-tarsus: 46% of soma), slim (mean maximum tibial height: 31% of mean length). Femora I and II both with three setae (0,2/1,0). Cerotegument rarely visible on legs.

Male

As for female except margin of genital orifice well separated from ventrosejugal apodeme. Soma smaller, idiosomal length 438 (semi-arid shrubland, n = 24, 411–465); 403 (mallee-heath, n = 10, 382–420).

Material examined

Holotype: ♀ (N1989194), soil, litter, moss and other low growth plants under bladder saltbush (*Atriplex vesicaria*) amongst sparse false sandlewood (*Myoporum platycarpum*), Koonamore Vegetation Reserve (32°07′S, 139°21′E), 27.vi.1974.

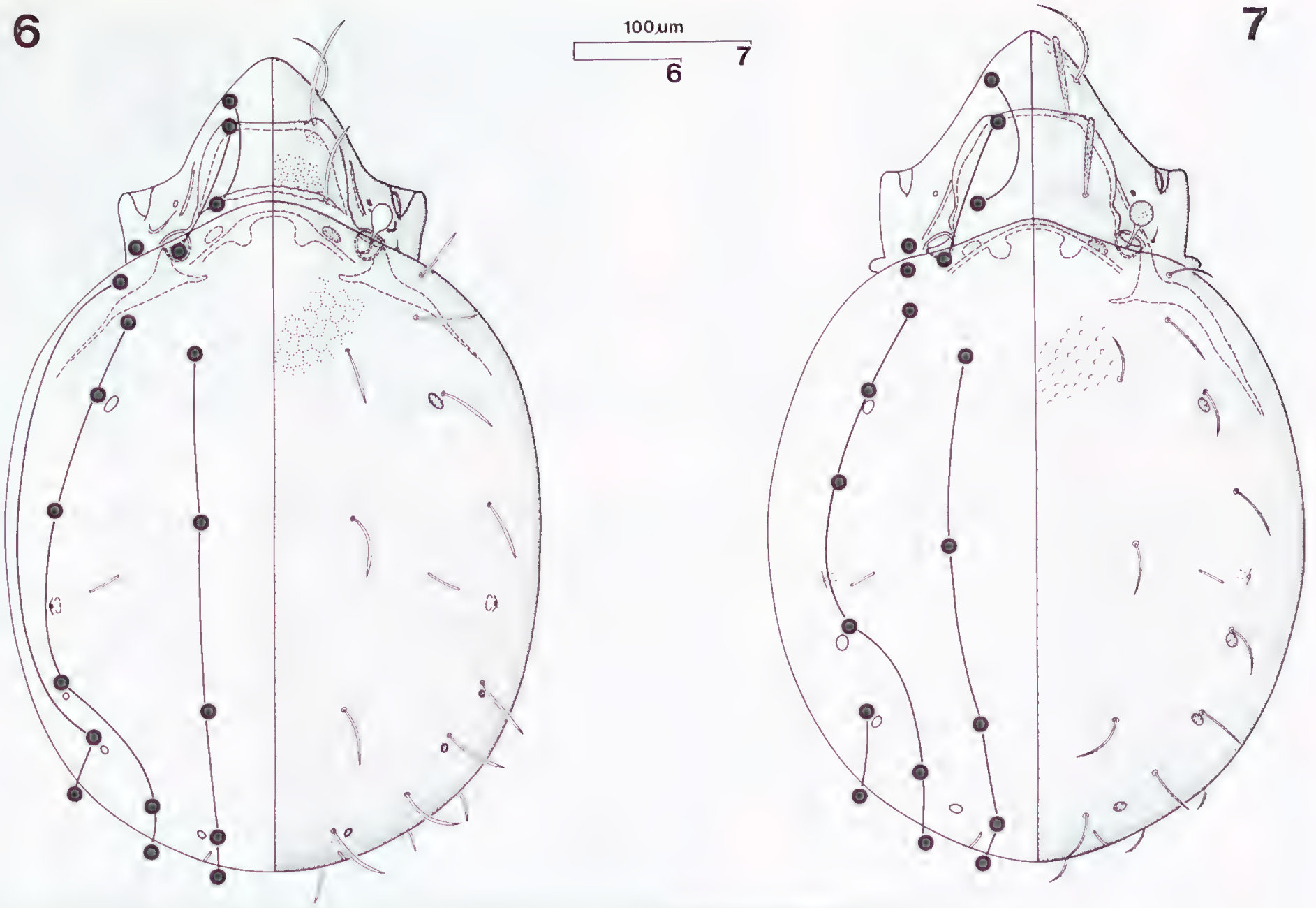
Paratypes: 5♀♀ (N1989195–N1989199), 18♂♂ (N1989200–N1989217); 2♀♀ – BMNH; 2♀♀ – FMNH; 2♀♀ NZAC; same data as holotype.

Undesignated: 1♀ (N1989218), bases of love grass (*Eragrostis eriopoda*) tussocks, near Emu (28°41′S, 132°08′E), 11.x.1976. 3♀♀ (N1989219–N1989221), 10♂♂ (N1989222–N1989231), sand, litter, under banksia shrubs (*Banksia ornata*), Tamboore Homestead (35°57′S, 140°29′E), 4.viii.1974.

Distribution

Australia (Aa), South Australia. Arid tussock grassland (Great Victoria Desert), West Plateau, 1♀ / 1 of 8 × 25cm^2. Semi-arid low shrubland (Koonamore Vegetation Reserve), Lake Eyre Basin, 6♀♀, 24♂♂ / 4 of 8 × 25cm^2. Mallee-heath, tall open shrubland (Tamboore Homestead, near Mt Rescue Conservation Park), Murray-Darling Basin, 3♀♀, 10♂♂ / 3 of 8 × 25cm^2.

FIGURES 4 and 5. Right legs, posterior aspect to femur-pretarsus, showing setae only on femora I and II. 4, *Ceroribatula incrustata* sp. nov., legs I – IV. 5, *Ceroribatula monozygata* sp. nov., legs I and II. Notation: d = dorsal, v = ventral.



FIGURES 6 and 7. Somal notum. 6, *Ceroribatula bizygata* sp. nov.; 7, *Ceroribatula monozygata* sp. nov..

Remarks

Ceroribatula monozygata is regarded, along with *C. bizygata,* as the most primitive species, having the least number of femoral setae. The cerotegument is thin and inconspicuous and because of the size of the notal setae and form it looks very similar to *C. incrustata* without any incrustation. The prefix of its name is derived from the Greek '*monos*' meaning 'one' and, in a similar manner to the formation of the name of *C. bizygata,* it refers to the presence of a single translamella, without a second 'translamella'.

Ceroribatula trirostrata sp. nov.
Figs 8 and 9

Female

Dorsal profile of hysteronotum ovoid, dark brown, cerotegument forms continuous notal (except over lenticulus) and pleural layer, medium thickness (subequal to 3× diameter of setal base), including refractile wax granules (where thick, form irregular white patches) and attached vegetable detritus, obscuring setae, sculpturing and foramina. Idiosomal length 745 (n=1). Leg lengths (femur-tarsus): I - 368, II - 342, III - 352, IV - 427. Tibial maximum heights: I - 33, II - 26, III - 21, IV - 21.

Proteronotum with translamella mainly costate (brief laminar part near seta *z*1), laminar lamellae, sublamellae costate (merging anteriorly with lamellae). Setae *j*2 and *z*1 subequal in length, hyaline, ensiform, weakly ciliate. Short subtutorium. Caput of seta *z*2 without cilia. Integument reticulate between *j*2-*j*2. Rostrum tripartite with two incisions.

Hysteronotal setae subequal in length, short, ensiform, without cilia. Lenticulus smooth, pale, otherwise integument foveate. Anterior foramen (*F*3) long and narrow compared with suboval posterior foramina (*F*4, *F*5, *F*6).

Podosternum with subpedal ridges fragmented into distinct parts and custodial ridge absent. Coxite setae in rank 2 of legs I,II,III longer than in rank 1. Midsternal and postpedal apodeme present. Integument foveate, and patch of finely punctate sculpturing between setae *I*1-*I*1 (not illustrated in Fig. 9).

Opisthosternal setae either setose (*JZg*1-4, *Sg*, *Sa*1) or ensiform (*JZa*1-2, *Sa*2, *Sa*3). Integument foveate. Eggs oval, 237 × 106 (32% of female length), smooth exochorion, 14 eggs in single female.

Legs long (mean femur-tarsus: 50% soma), very slim (mean maximum tibial height: 24% of mean length). Leg III with long femur, unusual in being longer than leg II. Femur I with four setae (0,2/2,0), femur II with three setae (0,2/1,0). Some cerotegument around basal leg segments.

Male

As female, except hysteronotal foramen *F*3 about half length although similarly narrow, and margin of genital orifice well separated from ventrosejugal apodeme. Soma smaller, idiosomal length 639 (n = 2, 660, 617).

Material examined

Holotype: ♀ (N1989232), soil, litter, moss and other low growth plants under bladder saltbush (*Atriplex vesicaria*) amongst sparse false sandlewood (*Myoporum platycarpum*), Koonamore Vegetation Reserve (32°07′S, 139°21′E), 27.vi.1974.

Paratypes: 2♂♂ (N1989233, N1989234), same data as holotype.

Distribution

Australia (Aa), South Australia. Semi-arid low shrubland (Koonamore Vegetation Reserve), Lake Eyre Basin, 1 ♀, 2 ♂♂/ 3 of 8 × 25cm^2.

Remarks

The name of *Ceroribatula trirostrata* is from the Latin '*tres*' meaning 'three' and it refers to the rostrum which is broken up by two incisions into three parts. It is similar to *C. incrustata* in having four setae on femur I, but is superficially like *C. bizygata* because of its proteronotal ridges and setae. It is also similar to species of *Zygoribatula,* especially those with a long, slim hysteronotal multiporose foramen *F*3 such as *Z. longiporosa* Hammer, 1953 from Queensland. Whilst *Z. longiporosa* is similar, it has five setae on both femora I and II, the integument is smooth with an inconspicuous cerotegument.

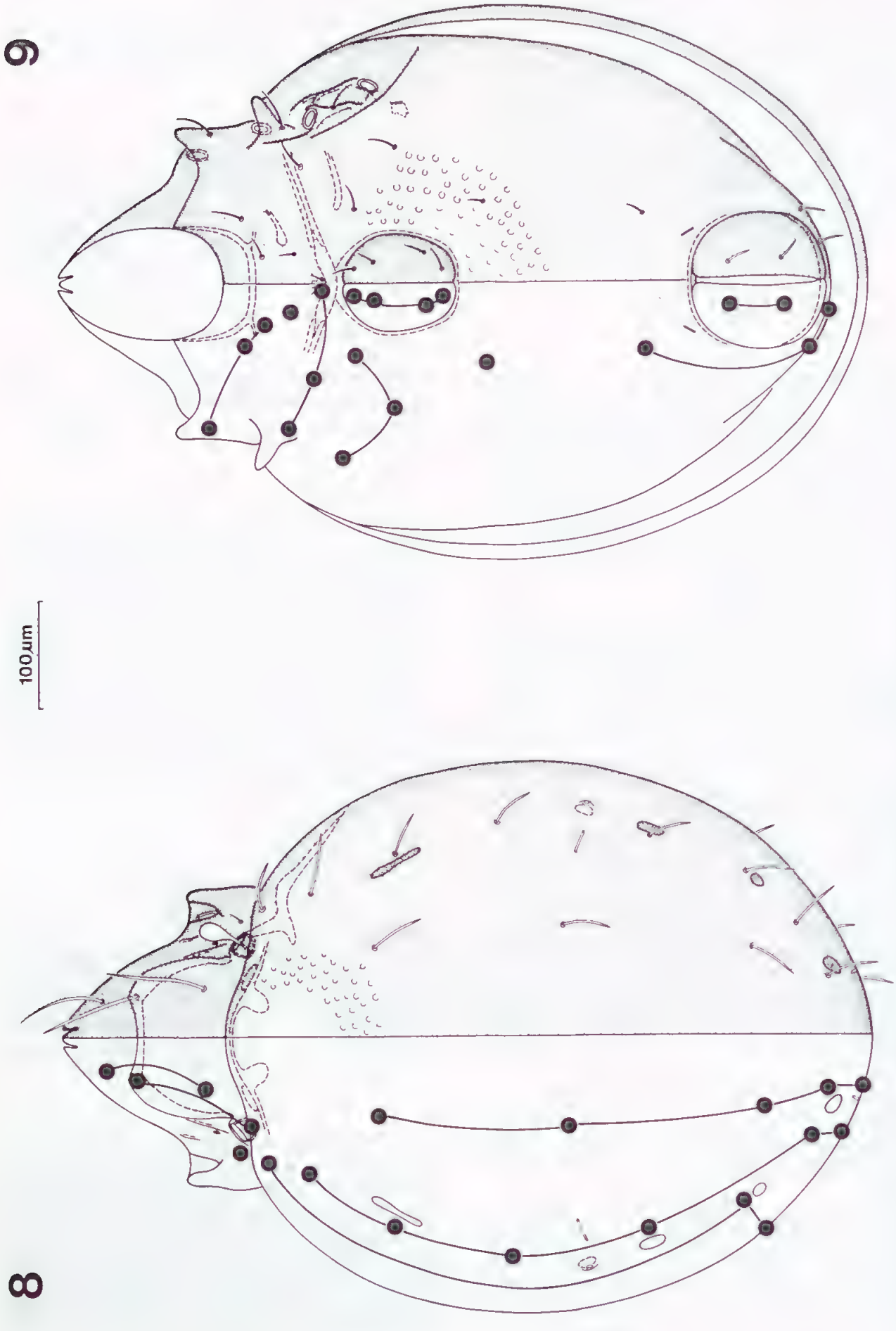
***megaforamina*-complex**

Diagnosis

Ceroribatula. Hysteronotal setae (longer than 0.5× distance between bases), proteronotal seta *s*1 (longer than diameter of bothridial aperture) and trochanter I seta *v* (longer than distance between setae *I*1-*I*2) medium length. Translamella absent. Femur I with seta *v*2 (0,2/2,0).

Remarks

The *megaforamina*-complex is regarded as derived from the *incrustata*-complex in having four setae on femur I and medium-length setae on the hysteronotum and elsewhere. These character states and the absence of a translamella make it similar to *Fovoribatula mesosetosa* sp. nov., but the absence of posterior setae on femora I and II indicates that it belongs to a separate lineage. It includes only the nominate species, *C. megaforamina.*



FIGURES 8 and 9. *Ceroribatula trirostrata* sp. nov., female soma. 1, notum; 2, idiosternum.

Ceroribatula megaforamina sp. nov.
Figs 10 and 11

Female

Dorsal profile of hysteronotum subcircular, colour light brown, cerotegument inconspicuous. Idiosomal Length: 580 (n = 6, 540–617). Leg lengths (femur-tarsus for idiosomal length 609): I – 332, II – 311, III – 306, IV – 386. Tibial maximum heights (for 609): I – 26, II – 21, III – 19, IV – 18.

Proteronotum with weakly laminar lamellae and costate sublamellae. Seta *j*2 slightly longer (more than 1.1×) than *z*1, both ciliate and bacilliform. Integument smooth. Sensory seta *z*2 clavate, with globose caput and many fine, pointed cilia, smaller and more numerous than represented (Fig. 10).

Hysteronotal setae mostly subequal in length, but *S*1 shorter, with three longitudinal files of cilia. Lenticulus smooth, pale, surrounding integument foveate with small, well spaced pits. Multiporose foramina large, anterior one (*F*3) largest, oval.

Podosternum with circumpedal ridge merged with rest of subpedal ridge, extending to weak custodial ridge fading just anterior to pedotectum II. Two adaxial setae on coxite I similar in length (*I*1 and *I*2 subequal). Integument foveate around midline, smooth peripherally.

Opisthosternum with setae of fairly uniform length, *Sa*1 subequal to *Sa*3. Adanal pore *Saf* nearly longitudinal, further from anal orifice than its length. Eggs oval, 223 × 100 (mean of 15 horizontally aligned eggs), 39% of mean female

FIGURE 10. *Ceroribatula megaforamina* sp. nov., female notum.

length, smooth or wrinkled exochorion. Number of eggs in female (number of females) as follows: six (2), seven (1), eight (3).

Legs long (mean femur-tarsus: 54% of soma), slim (mean maximum tibial height: 22% of mean length). Leg IV unusually long and slim with spinate ventral setae on tibia and tarsus (Fig. 11). Only four setae on femur I (0,2/2,0) and three setae on femur II (0,2/1,0).

Male

As female except two specimens (idiosomal length 486 and 563) with clear, finely punctate cerotegument covering hysteronotum other than over lenticulus, all specimens with margins of genital orifice not merging with ventrosejugal apodeme. Soma smaller, idiosomal length: 518 (arid grassland, n = 15, 439–568); 439 (Semi-arid shrubland, n = 1).

Material examined

Holotype: ♀ (N1989235), bases of lovegrass (*Eragrostis eriopoda*) tussocks, near Emu (28°41′S, 132°08′E), 11.x.1974.

Paratypes: 5 ♀♀ (N1989236–N1989240), 12 ♂♂ (N1989241–N1989252); 1 ♂ – BMNH; 1 ♂ – FMNH; 1 ♂ – NZAC; same data as holotype.

Undesignated: 2 ♂♂ (N1989253, N1989254) same data as holotype. 1 ♂ (N1989255), soil, litter, moss and other low growth plants under bladder saltbush (*Atriplex vesicaria*) amongst sparse false sandlewood (*Myoporum platycarpum*), Koonamore Vegetation Reserve (32°07′S, 139°21′E), 27.vi.1974.

Distribution

Australia (Aa), South Australia. Arid tussock grassland (Great Victoria Desert), West Plateau, 6 ♀♀, 17 ♂♂/ 4 of 8 × 25cm^2. Semi-arid low shrubland (Koonamore Vegetation Reserve), Lake Eyre basin, 1 ♂/ 1 of 8 × 25cm^2.

Remarks

The relationships of *Ceroribatula megaforamina* are considered under the 'Remarks' on the *megaforamina*-complex. Its name is based on the Greek '*mega*' meaning 'large' and the Latin '*foramen*' meaning 'hole', referring to the large size of the multiporose hysteronotal foramina. The integument is very clean for a species of *Ceroribatula,* most specimens being without any evident cerotegument or attached vegetable detritus. Even the two males that are covered in fine, regular deep punctata, apparently representing fine canals through a shallow cerotegument, are without attached detritus. Besides their punctata, no differences from other specimens were recognised for these two males. It is assumed that they belong to the same species and have an ephemeral cerotegument, but they are not included in the type series in case this is contradicted by further evidence.

Genus ***Fovoribatula*** gen. nov.

Type-species: *Fovoribatula brevisetosa* sp. nov.

Diagnosis

Fovoribatulinae. Hysteronotal setae short or medium-length, not longer than distance between their bases. Lenticulus present, associated with mid-dorsal forward pointing protruberance of hysteronotum. Lamellae present, laminar and complete (between *z*1–*z*2). Translamella present (costate) or absent. Rim of bothridium (base of seta *z*2) low, not turret-like. Four pairs of hysteronotal multiporose foramina. Discidium present as costate ridge. Femora I and II with four setae, posterior setae present (0,2/1,1). Pretarsal claws long (central claw II more than 0.3× length of tarsus II).

Remarks

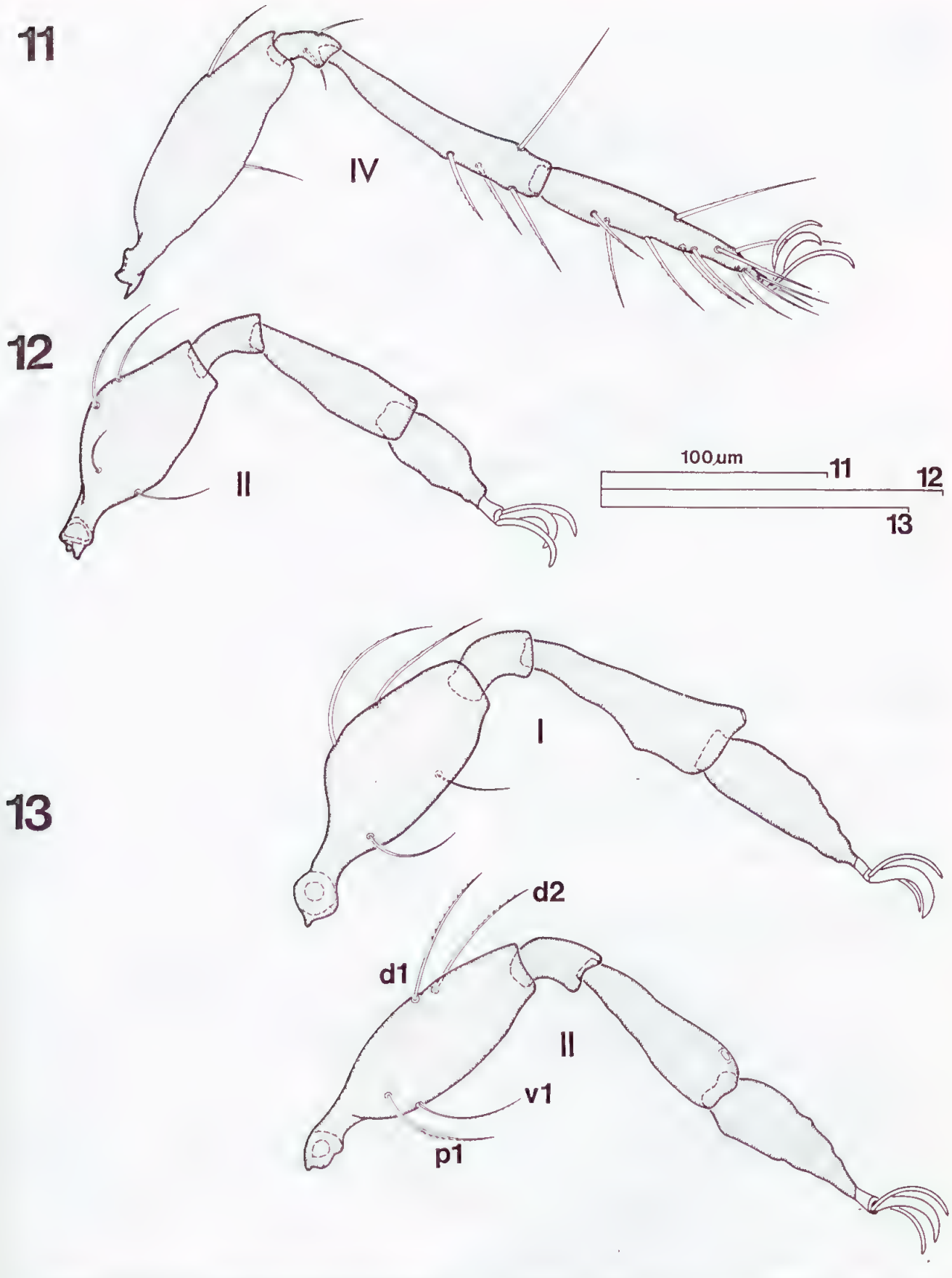
Fovoribatula is superficially similar to the South Australian genus *Ceroribatula* gen. nov., but it is regarded as more closely allied to *Decoribatula* Lee & Birchby, 1989, from Singapore, because of the chaetotaxy on femora I and II. But it is noted that on femur I the ventral seta is positioned as *v*2 not *v*1 as on *Decoribatula.* Other similarities to *Decoribatula* are the larger pretarsal claws (not conspicuously so on *Fovoribatula mesosetosa*) and leg II being shorter than leg III (femur-tarsus), only known for *C. trirostrata* among the *Ceroribatula.* The name is derived from the Latin '*fovea*' meaning 'pit', refering to the foveate (pitted) integument of its members, whilst the cerotegument is not conspicuous as in most members of *Ceroribatula.* It includes two species which are dissimilar in their proteronotal ridges, hysteronotal setae and pretarsi. Whilst the type-species is unusual in appearance and is considered as being the more derived, the other species (*F. mesosetosa*) is similar to *Ceroribatula megaforamina* sp. nov., both possessing derived character states. Whilst *F. brevisetosa* has unusually large lateral claws on the pretarsus approaching the relative size of *Decoribatula pustulata,* those on *F. mesosetosa* are larger than for *Ceroribatula* although not obviously so. *Fovoribatula* includes two new species as follows: *F. brevisetosa, F. mesosetosa.*

Fovoribatula brevisetosa sp. nov.

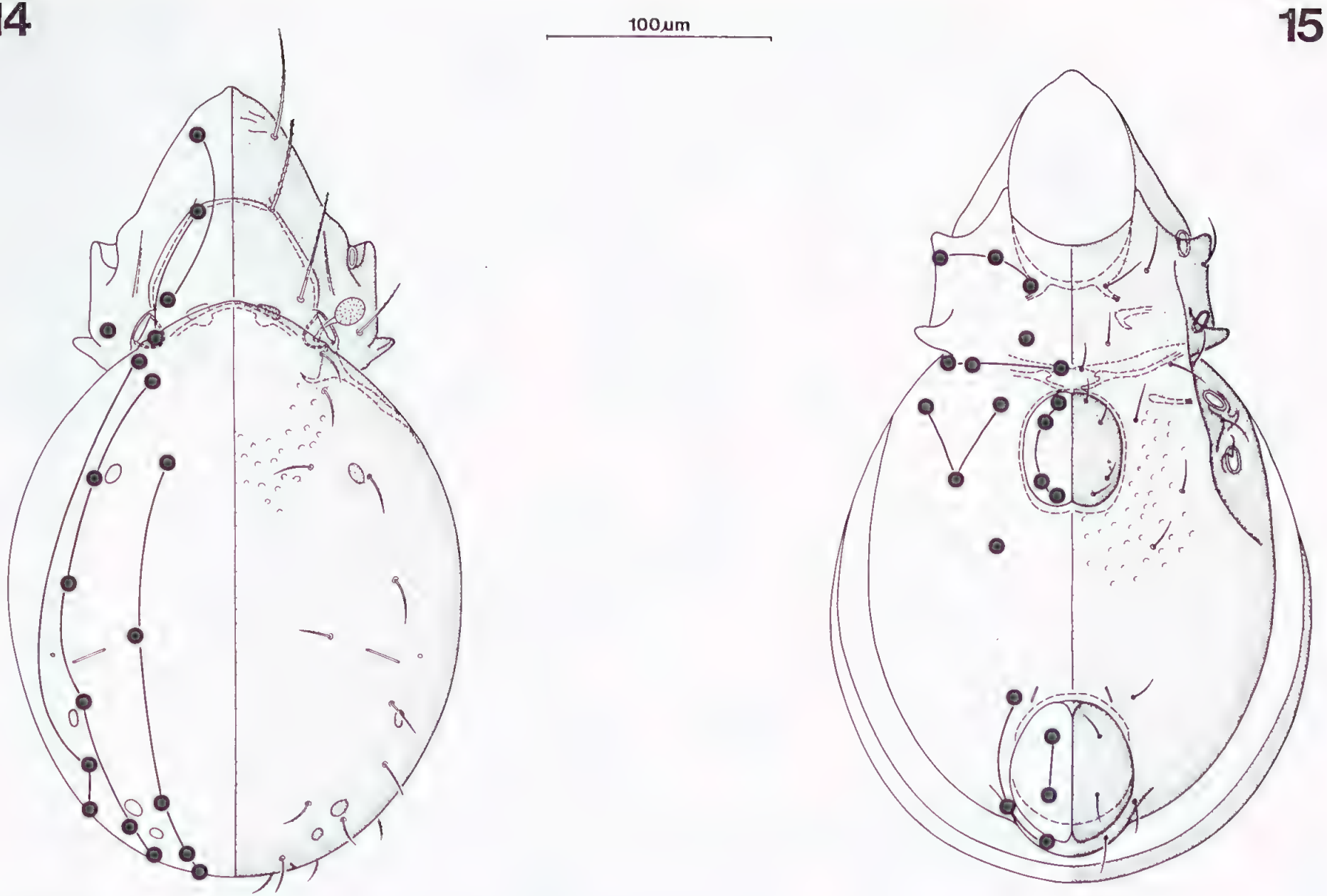
Figs 12, 14, 15

Female

Dorsal profile of hysteronotum ovoid, light brown, cerotegument inconspicuous. Idiosomal



FIGURES 11, 12 and 13. Right legs, posterior aspect to femur-pretarsus showing setae on all segments of leg IV and femora only of legs I and II. 11, *Ceroribatula megaforamina* sp. nov., leg IV. 12, *Fovoribatula brevisetosa* sp. nov., leg II. 13, *Fovoribatula mesosetosa* sp. nov., legs I and II. Notation: d = dorsal, v = ventral, p = posterior.



FIGURES 14 and 15. *Fovoribatula brevisetosa* sp. nov., female soma. 14, notum; 15, idiosternum.

length 375 (n=1). Leg lengths (femur-tarsus): I - 213, II - 170, III - 193, IV - 213. Tibial maximum heights: I - 21, II - 18, III - 13, IV - 13.

Proteronotum with translamella costate, lamellae weakly laminar, costate near seta *z*1, no sublamellae, linear subtutorium. Setae *j*2 and *z*1 subequal in length, *z*1 more robust. Caput of seta *z*2 with minute cilia. Integument smooth except for transverse wrinkles on rostrum.

Hysteronotal setae subequal in length, short, setose, weakly ciliate. Lenticulus smooth, pale, otherwise integument with weak, sparse foveate sculpturing. Anterior foramen (*F*3) oval, similar in size to *F*5.

Podosternum with circumpedal ridge merged in with a continuous subpedal ridge, extending to weak custodial ridge fading level with seta *I*3. Two adaxial setae on coxite I similar in length (*I*1 and *I*2 subequal).

Opisthosternum with setae of fairly uniform length, adaxial shorter. Adanal pore *Saf* oblique, sloping inwards anteriorly, closer to anal orifice than its length. Eggs oval, 175 × 69 (mean of 3 eggs present), 47% of female length, smooth exochorion.

Legs long (mean femur-tarsus: 52% of soma), slim (mean maximum tibial height: 26% of mean length). Seta *v* on trochanter I reaches forward to level of *v*2 on femur I. Claws large, lateral claws more than half as stout as central claw.

Male

Differs from female in that anterior margin of hysteronotal shield has tectum extending forward to cover posterior half of bothridium to seta *z*2. Genital shield smaller, anterior margin to genital orifice not abutting onto ventrosejugal apodeme, level with seta *IV*1. Soma smaller, idiosomal length 368 (n=1).

Material examined

Holotype: ♀ (N1989256), sand, litter, under banksia shrubs (*Banksia ornata*), Tamboore Homestead (35°57′S, 140°29′E), 4.viii.1974.

Paratype: 1♂ (N1989257) same data as holotype.

Distribution

Australia (Aa), South Australia. Mallee-heath, tall open shrubland (Tamboore Homestead, near Mt Rescue Conservation Park), Murray-Darling basin, 1 ♀, 1 ♂/ 2 of 8 x 25cm^2.

Remarks

Fovoribatula brevisetosa is the type-species of the genus. The prefix of the name is derived from the Latin '*brevis*' meaning short and this refers to the length of the hysteronotal setae. It is unusual amongst the Fovoribatulinae in having short tarsi and the largest pretarsal claws for an Australian species, approaching the size of those in *Decoribatula* from Singapore, as well as having the largest known egg. The larger pretarsal claws are considered derived and an indication that *Fovoribatula* is allied to *Decoribatula*. The shortness of the dorsal setae is regarded as a regression, convergent with a similar character state on the primitive species of *Ceroribatula*, because certain setae (*s*1 on proteronotum and *v* on trochanter I) are relatively long and, therefore, considered derived.

Fovoribatula mesosetosa sp. nov.

Figs 13, 16, 17

Female

Dorsal profile of hysteronotum oval, colour medium brown, cerotegument shallow, containing wax granules in white patches anteriorly and posteriorly on soma and on hysteronotal humeral region. Idiosomal length: 536 (n = 2, 519,553). Leg lengths (femur-tarsus for idiosomal length 519): I - 254, II - 236, III - 244, IV - 303. Tibial maximum heights (for 519): I - 26, II - 18 , III - 18 , IV - 18.

Proteronotum without translamella, lamellae substantially laminar anteriorly, costate near seta *z*2, sublamellae costate or more rarely linear and weak, linear subtutorium. Seta *j*2 shorter (about 0.85×) than *z*1, both ciliate and bacilliform. Sensory seta *z*2 with fine, pointed cilia on caput. Integument smooth.

Hysteronotal setae mostly subequal in length, but *J*6, *Z*6, *S*1 and *S*6 shorter, with three longitudinal files of cilia. Pale lenticulus with sparse, very shallow alveolae, surrounding integument clearly foveate. Multiporose foramina small, subequal, oval.

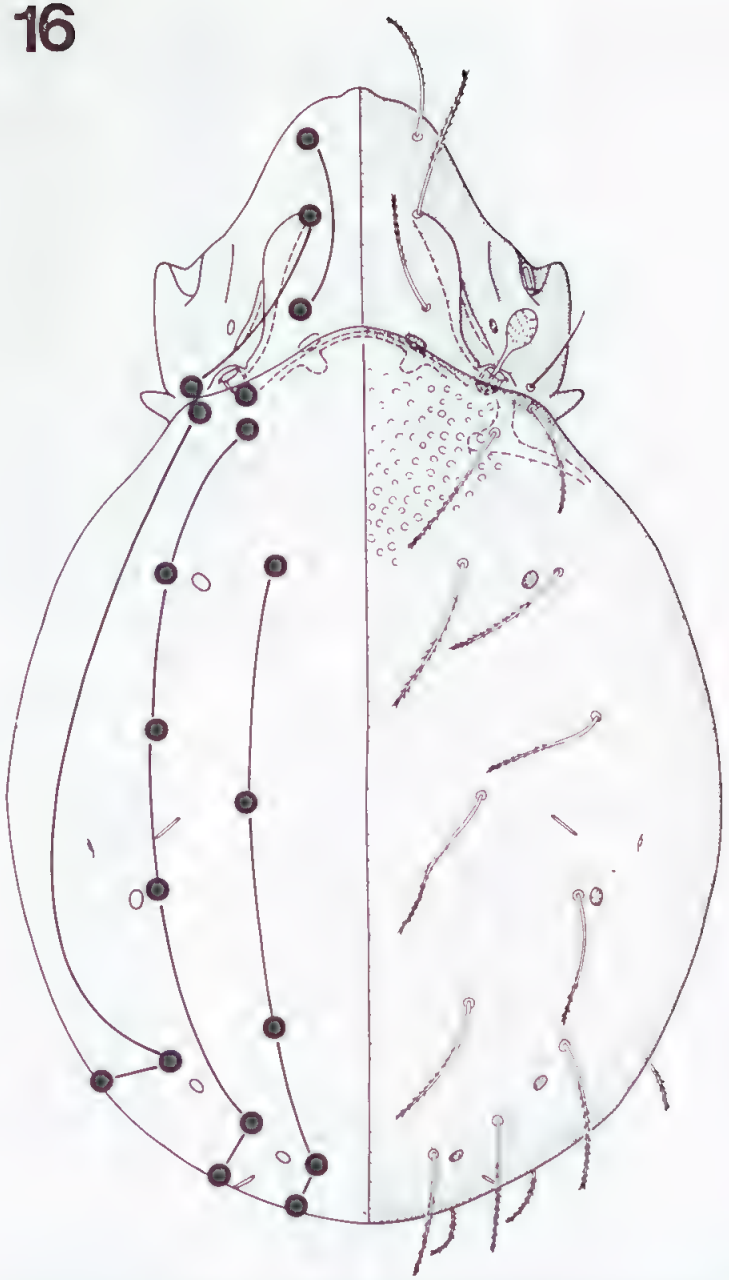
Podosternum with circumpedal ridge merging with subpedal ridge as far anterior as pedotectum II. Two adaxial setae on coxite I similar in length (*I*1 and *I*2 subequal), peripheral setae, especially *III*3, longer. Integument smooth.

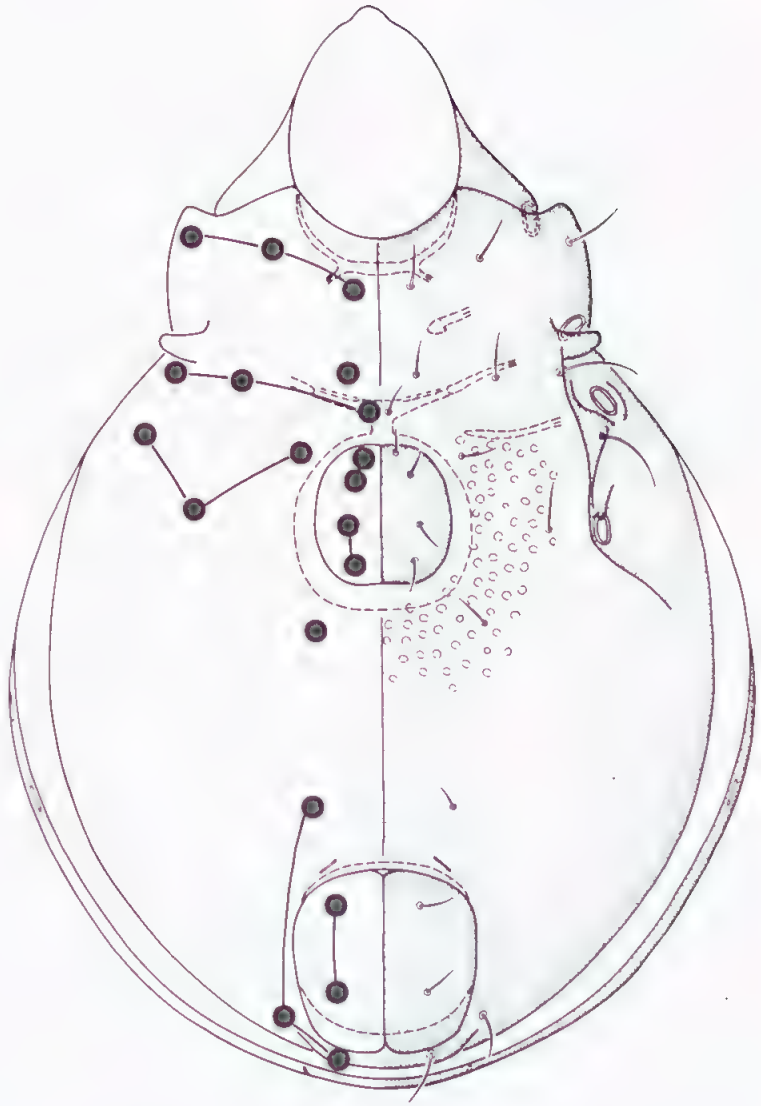
Opisthosternum with setae fairly uniform in length, except that *Sa*1 is short and *Sa*2, *Sa*3 are long. Adanal pore *Saf* nearly parallel to margin of anal shield. Eggs oval, 161 × 77 (mean of 6 horizontally aligned eggs), 30% of mean female length, smooth exochorion. Number of eggs in female (number of females) as follows: one (1), ten (1).

Legs long (mean femur-tarsus: 50% of soma), slim (mean maximum tibial height: 29% of mean length). Claws large, but lateral claws less than half as stout as central claw.

Male

As female except that margin of genital orifice not merging with ventrosejugal apodeme. Soma smaller, idiosomal length: 491 (n = 7, 455–514).





FIGURES 16 and 17. *Fovoribatula mesosetosa* sp. nov., female soma. 16, notum; 17, idiosternum.

Material examined

Holotype: ♀ (N1989258), soil, litter, moss and other low growth plants under bladder salt bush (*Atriplex vesicaria*) amongst sparse false sandlewood (*Myoporum platycarpum*), Koonamore Vegetation Reserve (32°07′S, 139°21′E), 27.vi.1974.

Paratypes: 1♀ (N1989259), 4♂♂ (N1989260-N1989263); 1♂ BMNH; 1♂ FMNH; 1♂ NZAC; same data as holotype.

Distribution

Australia (Aa), South Australia. Semi-arid low shrubland (Koonamore Vegetation Reserve), Lake Eyre basin, 2♀, 7♂♂/ 3 of 8 x 25cm^2.

Remarks

The prefix of the name of *Fovoribatula mesosetosa* is derived from the Greek '*mesos*' meaning 'middle', referring to the medium-length of the hysteronotal setae. It is easily distinguished from the only other species in its genus by the larger hysteronotal setae, absence of a translamella and relatively slimmer lateral pretarsal claws and shorter central claws. Central claw II (for example) is only slightly larger than those of *Ceroribatula.* It is superficially similar to *Ceroribatula megaforamina* as commented on in the 'Remarks' on *Fovoribatula.*

ACKNOWLEDGMENTS

We are indebted to the Australian Biological Resources Study for funding the salary of C.M.B. in a grant to D.C.L., as well as to Dr Henrik Enghoff (Zoological Museum, Copenhagen) for making two types available. Thanks are also due to Mrs Kathy Bowshall-Hill for the notation and presentation of the figures and Mrs Debbie Lowery for typing the manuscript.

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REVISION OF AUSTRALIAN SPECIES OF THE GENUS *HOLCONIA* THORELL (HETEROPODIDAE: ARANEAE)

D. B. HIRST

HIRST, D. B. 1991. Revision of Australian species of the genus *Holconia* Thorell (Heteropodidae: Araneae). *Rec. S. Aust. Mus.* 24(2): 91–109.

Australian species of the genus *Holconia* Thorell, 1877 are revised. *Holconia hirsuta* (L. Koch), *H. immanis* (L. Koch), *H. insignis* (Thorell) type species, and *H. nigrigularis* (Simon) are valid taxa. *Holconia subdola* Thorell is a synonym of *H. hirsuta*. *Isopeda simoni* Rainbow is a synonym of *H. nigrigularis*. *Mygale whitei* Bonnet is synonymised with *H. immanis*. The following new species are described: *H. colberti, H. flindersi, H. murrayensis, H. neglecta* and *H. westralia*.

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This is the fourth part of a revision of the Australian Heteropodidae excluding *Heteropoda* Latreille, 1804. Hirst (1990) revalidated the genus *Holconia* when outlining the genera and relimiting Australasian species involved in the genus *Isopeda (sensu lato)*. Here, Australian taxa of the genus *Holconia* are revised.

Koch (1867) described *Delena immanis* from Brisbane, at that time understandably selecting that genus as morphologically similar. Thorell (1870) erected the genus *Voconia*, for a new species, *V. insignis*. Koch (1875) transferred *immanis* to *Voconia* and described *V. dolosa*. Koch's understanding of that genus is questionable as at the same time he described *Isopeda hirsuta*, a species which should have been difficult to separate from *dolosa* or *insignis*, the latter which he redescribed. Finding *Voconia* preoccupied, Thorell (1877) replaced that name with *Holconia*. Three more species, *H. subdola, H. armillata* and *H. beccarii* were described by Thorell (1881, 1887, 1892). The latter two, being non-Australian, are not included in this revision. Hogg (1902) saw no reason for retaining *Holconia*, and synonymised it with *Isopeda*. Two further species, *I. nigrigularis* and *I. woodwardi* were described by Simon (1908). As the latter name was a homonym of *Isopeda woodwardi* Hogg, Rainbow (1911) replaced this with *simoni*. Little has been produced in the following years concerning this group of heteropodids regarded here as *Holconia*, but Bonnet (1957) proposed the name *Mygale whitei* for a species briefly described and illustrated by J. White (1790) and named only 'White-jointed spider'. Main (1985: 48) noted that the species was 'a sparassid (Sparassidae = Heteropodidae)'. The illustrations are undoubtedly of *H. immanis* and Bonnet probably chose the genus *Mygale* solely on the reference to that species as 'Mygale de White' by Walckenaer (1837).

Materials and Methods

Measurements were made with an eyepiece graticule on a Wild microscope and are given in millimetres except eye diameters, interspaces and MOQ (median ocular quadrangle) dimensions which are expressed as relative to the diameter of an AME. Other materials and methods are given in Hirst (1989). Acronyms are: AM – Australian Museum, Sydney; ANIC – Australian National Insect Collection, Canberra; BYM – Dr B.Y. Main, Zoology Department, University of Western Australia, Nedlands; MCG – Museo Civico di Storia Naturale 'Giacomo Doria', Genoa; NHMW – Naturhistorisches Museum, Wien; NHRM – Naturhistoriska Riksmuseum, Stockholm; NMV – Museum of Victoria, Melbourne; NTM – Northern Territory Museum, Darwin; QM – Queensland Museum, Brisbane; SAMA – South Australian Museum, Adelaide; SMNS – Stadtliches Museum für Naturkunde, Stuttgart; WAM – Western Australian Museum, Perth; ZMB – Museum für Naturkunde an der Universität Humboldt zu Berlin; ZMH – Zoologisches Museum, Hamburg.

Discussion

The term 'subembolic apophysis' (Figs 1–7, 15) was introduced (Hirst 1990) to describe the apophysis found in species of *Holconia* and distinguishing it from the tegular apophysis found in several other genera of the Deleninae. Those structures are probably homologous in function. With the exception of *H. nigrigularis* the subembolic apophysis bridges a 'gap' between the embolic base and the tegulum. Rising prodistally from the embolic base to a rounded point or 'knob', the subembolic apophysis is connected to the tegulum on the prodorsal side of the apophysis.

Holconia nigrigularis differs in having the subembolic apophysis rising more prolaterally on the embolic base (Fig. 14) adjacent to its junction with the tegulum, and not being fixed to the tegulum. This state also occurs in one species of a sister genus (Hirst in prep.) but then is smaller and accompanied by a reduced tegular apophysis.

A distinctive character of female *Holconia* species required a second term, the 'epigynal sclerite' (Fig. 25) in reference to a lateral convexity in the posterior half of the epigynum (Hirst 1990). The epigynal sclerite is a narrow to broad extension of the lateral rim of the epigynum over the postero-lateral corner of the fossa. In *Isopeda* and related genera the lateral rim turns sharply downwards to produce a concavity adjacent to the postero-lateral edge of the fossa. The epigynal sclerite is a useful diagnostic female character when used with epigynum shape and number of insemination duct coils.

Holconia Thorell

Voconia Thorell, 1870: 382.
Holconia Thorell, 1877: 485 (nom. nov. for *Voconia* Thorell, pre-occupied). Hirst, 1990: 17.
Isopeda: Hogg, 1902: 429 (in part).

Diagnosis

Males with subembolic apophysis. Tegulum prodistally rounded without apophysis. Female epigynum with convex epigynal sclerite extending over posterior lateral corner of fossa.

Description

Large spiders, carapace length often 9–15 mm, 6–9 times longer than high, highest posterior to ocular area; caput 'U' shaped; fovea long, narrow, deep. Anterior eye row slightly recurved; line drawn behind posterior eyes recurved; ALE largest; PLE often subequal to AME; PME smallest, low-domed, barely, or not visible in lateral view; AME closer to each other than to ALE. Clypeus 1/8 to 1/2 width of AME. Cheliceral groove with two promarginal teeth; four or five retromarginal teeth, distal tooth subequal or rather equal to subdistal tooth except in *H. immanis* in which it is larger. Labium barely wider than long, apex somewhat truncate. Sternum longer than wide, truncate anteriorly, broadest mid-length between second coxae, narrowing to a point between fourth coxae. Leg I, when outstretched alongside leg II, reaches to mid-length of metatarsus II, rarely to near distal end of metatarsus II. Three pairs of ventral spines on all tibiae with distal pair adjacent to articulation with metatarsi. Scopula on all metatarsi and tarsi, sparse on metatarsi IV, largely replaced by stout bristles. Abdomen usually with pattern of large ill-defined brown or blackish patches, broadly ovate in its normal condition, flattened dorso-ventrally. Male palpal tibial apophysis subequal in length to palp tibia, relatively straight, lanceolate, usually with incurved apex; membranous support on inner edge of apophysis base forms a somewhat continuous straight line with apophysis. Tegular apophysis absent. Embolic base with prodistal knob-like subembolic apophysis connected to tegulum, or semicircular and not connected to tegulum; embolic base rarely with granulated area, when present appears as a series of fine ridging (Fig. 14); area between conductor base and embolus broad, depressed (Fig. 14). Embolus with 7½ to 11½ coils in distal half of cymbium. Coil stack almost width of cymbium; first complete coil smaller than several subsequent coils, difficult to see in ventral view without manipulation of embolus. Tip of embolus constricts and tapers to a fine point in the last half a turn or less. Female epigynum large, roughly oblong but broader posteriorly; sclerotised lateral rims often somewhat parallel in anterior half; in posterior half a convex extension of the lateral rim, the epigynal sclerite, extends partly over fossa. Fossa smooth, rarely darkly pigmented, often narrower and somewhat truncate posteriorly; posterior section often with depressed or raised areas. Fossa and sclerotised rim lack setae. Vulva with paired insemination ducts coiled 8–11 times; spermathecae with moderately long, usually curved, spermathecal sacs.

Type species

Voconia insignis Thorell, 1870.

Remarks

Spermathecal sacs may be widely separated (fig. 10, Hirst 1990) or close together (Fig. 23). They appear to be intraspecifically variable and diagnostically useful only at generic level. Colouration of *H. immanis* and *H. nigrigularis* is distinctive but other species are uniformly coloured. Spination and leg lengths are very similar within the genus. Leg ratios (leg length / carapace length) are also intraspecifically variable. Leg lengths and spination are given for the type species, *Holconia insignis* in Hirst (1990).

Four species groups or sister groups are outlined within the genus, but these are equivocal as definitions of the groups alter if different character combinations are used. *Holconia nigrigularis* lacks the fixed subembolic apophysis of other species and has a much flatter carapace which isolate this species from others in the genus. On the other hand, the presence of four retromarginal cheliceral teeth and a broader male palpal tibial apophysis ally this species with a further group, comprising *H. colberti* and *H. westralia,* but which has more coils in the

embolus and insemination duct as well as a relatively higher carapace, and in the case of *H. colberti,* occasionally five retromarginal cheliceral teeth.

Grouping of remaining species may be determined by the degree of coiling of the embolus or insemination ducts and carapace height. The largest group comprises *H. insignis, H. flindersi, H. murrayensis* and *H. immanis.* While *H. immanis* is easily diagnosed by its distinctive pattern and larger subembolic apophysis, other species in this group are difficult to separate. This is further complicated by the sympatric occurrence in part of the distributions of *insignis/murrayensis* and *murrayensis/flindersi* (Fig. 36). Grouping by another character, the distal retromarginal cheliceral tooth, isolates *H. immanis* from all other *Holconia* species in having that tooth the largest.

Holconia hirsuta and *H. neglecta* can be grouped on their reduced embolic and insemination duct coiling but may well be included in the previous group. *H. hirsuta* differs in the marginally greater spacing between the median and subdistal retromarginal teeth (Fig. 20), in which it is paralleled by *H. westralia* (Fig. 21), but a similar spacing of those teeth is occasionally found in *H. insignis* (Fig. 19).

Key To The Species Of *Holconia*

1 — Abdomen with ventral pattern.....2
— Abdomen lacks ventral pattern.....3
2 — Abdomen without strong dorsal pattern; venter with ill-defined grey-black patch. Carapace very flat, depressed medially. Clypeus less than ¼ width of AME. Embolic base with low rounded subembolic apophysis. Epigynum broad and rounded; epigynal sclerite narrow, short to moderate length.....*nigrigularis* (Simon)
— Abdomen with conspicuous black stripe in anterior half; venter with blackish badge markings, pale bordered. Distal retromarginal cheliceral tooth largest. Subembolic apophysis high, knob-like. Epigynum lateral rims slightly diverging; epigynal sclerite broad, long.....*immanis* (L. Koch)
3 — Carapace low, about 7–8 times longer than high; clypeus about ⅓ width of AME. 5 retromarginal cheliceral teeth.....4
— Carapace higher, about 6 times longer than high; clypeus ½ width of AME. Usually with 4 retromarginal cheliceral teeth.....8
4 — Males with 7½ to 8 embolic coils. Females with a similar number of insemination duct coils..5
— Males with 9 to 10 embolic coils. Females with a similar number of insemination duct coils....6
5 — Males with small subembolic apophysis. Female epigynum with somewhat parallel lateral rims at first then sharply diverging; epigynal sclerite small, short.....*hirsuta* (L. Koch)
— Males unknown. Females with 8 insemination duct coils; epigynum with gradually diverging lateral sides, broad posteriorly; epigynal sclerite narrow at posterior only.....*neglecta* sp. nov.
6 — Males with 9½ to 10 embolic coils. Female with about 10 insemination duct coils.....7
— Males with 9 to 9¼, rarely to 9½ embolic coils. Female with about 9 insemination duct coils; epigynum with anterior half of lateral side slightly diverging; epigynal sclerite less than ½ length of epigynum.....*murrayensis* sp. nov.
7 — Male subembolic apophysis broad at apex. Female epigynum with anterior section of lateral side parallel over ½ length of epigynum; epigynal sclerite 2/5 length of epigynum.....*flindersi* sp. nov.
— Male subembolic apophysis narrow at apex. Female epigynum with anterior section of lateral side slightly diverging for ½ length of epigynum; epigynal sclerite usually ½ length of epigynum.....*insignis* (Thorell)
8 — Male with 9¾ to 10¼ embolic coils; subembolic apophysis smallish. Female epigynal sclerite long, narrow.....*westralia* sp. nov.
— Males with 11 to 11⅔ embolic coils; subembolic apophysis broad. Female epigynal sclerite short, broad.....*colberti* sp. nov.

The *insignis* Group

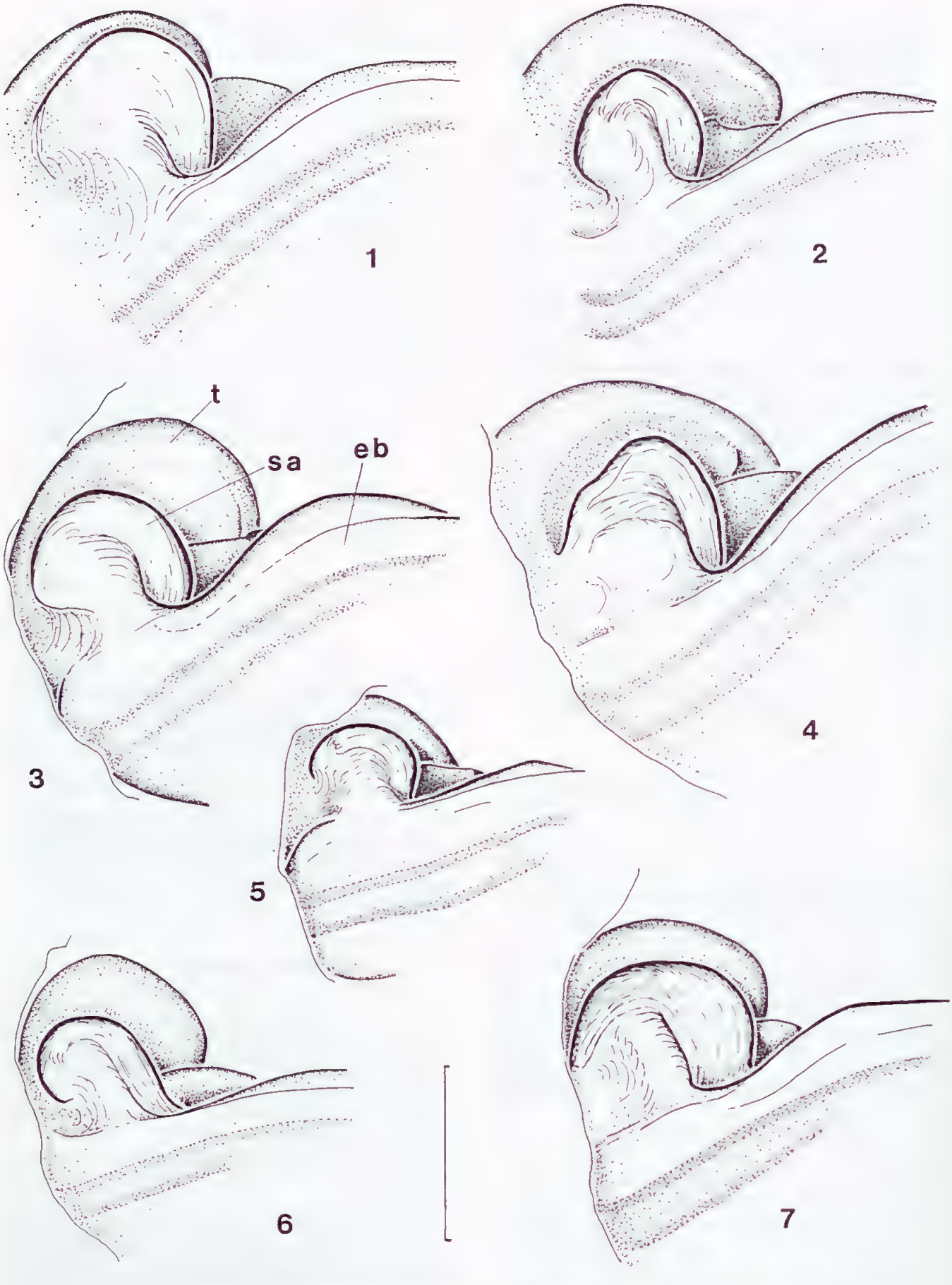
Clypeus width about ⅓ diameter of AME. Male with 9 to 10 embolus coils; subembolic apophysis largish. Female epigynum relatively narrow to broad; lateral rims not diverging greatly to posterior. *H. insignis, H. flindersi, H. murrayensis* and *H. immanis* are included in this grouping although the last differs in having a larger distal retromarginal cheliceral tooth and possesses a distinctive pattern. In other respects *H. immanis* is most similar to *H. insignis.* The group has an eastern and south-eastern distribution.

Holconia insignis (Thorell)
(Figs 2, 19, 24, 36)

Voconia insignis Thorell, 1870: 383. Syntypes ♂ and ♀, Queensland, Australia, Pessler, NHRM (Thorell Coll.), examined.
Holconia insignis: Karsch, 1878: 791. Hirst, 1990: 18, figs 6–10, table 4.
Isopeda insignis: Hogg, 1902: 432.

Diagnosis

Male subembolic apophysis rounded, apex curved slightly to venter; embolus with 9½ to 10 coils. Female epigynum broad anteriorly; lateral rims somewhat parallel or slightly diverging in anterior half, broadest posteriorly; epigynal sclerite long, usually greater than half length of fossa. Insemination ducts with about 10 coils (Fig. 24).



FIGURES 1–7. Subembolic apophysis of *Holconia* males: 1, *H. immanis* (L. Koch), SAMA N1988515; 2, *H. insignis* (Thorell), SAMA N1988522; 3, *H. flindersi,* holotype; 4, *H. murrayensis,* holotype; 5, *H. hirsuta* (L. Koch), QM S12592; 6, *H. westralia,* holotype; 7, *H. colberti,* holotype. eb, embolic base; sa, subembolic apophysis; t, tegulum. Scale line 0.5mm.

Variation

Carapace length of males, 9.68–12.90, mean 11.78 (n=8), 2 with 9½ embolus coils, 4 with 9¾ and 2 with almost 10 coils. Carapace length of females, 12.10–15.80, mean 13.44 (n=7). Usually with 5 retromarginal cheliceral teeth; distal tooth often angled more anteriorly, spaced about a tooth width apart and rather equal or subequal to subdistal tooth (Fig. 19).

Distribution

Occurs in Queensland and New South Wales in and west of the Great Dividing Range from near Rockhampton to south of Sydney. In Queensland it occurs westward to Injune and, in New South Wales, to Cobar and Lake Cowal (Fig. 36).

Other material examined

Queensland: ♀, 2 juv., Banana, 24°28′S, 150°08′E, AM KS19737; ♀, Condamine, 26°56′S, 150°08′E, AM KS19646; ♀, Eidsvold, 25°22′S, 151°07′E, QM S12595; ♀, same locality, SAMA N1988520; 2 juv., Enfield Station, 27°06′S, 151°02′E, QM; ♀, Goondiwindi, 28°33′S, 150°18′E, QM S12596; ♂, ♀, Injune, 25°51′S, 148°34′E, QM 14143; juv., Kroombit Tops, 24°26′S, 150°43′E, QM; 3 ♀♀, 6 juv., Lake Nuga Nuga, 25°01′S, 148°42′E, QM S12597; juv., Marlaybrook 26°54′S, 151°36′E, QM; ♂, Moombah, *ca* 27°59′S, 149°18′E, QM S12598; juv., Mt Archer, Kilcoy, 26°59′S, 152°38′E, QM; ♂, Ottley, 28°20′S, 149°04′E, QM 14142; ♀, St George, 100 km S of, AM KS19736; ♀, Theodore, 24°57′S, 150°05′E, QM; ♂, Wallumbilla, 26°35′S, 149°11′E, QM 14144. **New South Wales:** ♀, Bathurst, 33°25′S, 149°35′E, AM KS16701; ♂, Bonnet Bay, Sydney, AM KS19675; 3 juv., Brooklana, 30°16′S, 152°53′E, AM KS19677–8; ♀, Crowther, 34°06′S, 148°30′E, AM KS19651; ♂, Lake Cowal, 33°36′S, 147°26′E, ANIC; ♀, Loftus, 34°03′S, 151°03′E, AM KS16693; juv., Marrickville, Sydney, AM KS119649; ♂, Nyngan, 31°34′S, 147°12′E, AM KS16478; ♂, penult. ♀, Pilliga Scrub, 30°40′S, 148°50′E, SAMA N1988522–3; penult. ♀, Ryde, Sydney, AM KS13799; ♀, Sydney, 33°53′S, 151°13′E, AM KS16705; ♀, Woronora, Sydney, AM KS16695; ♀, Young, 34°19′S, 148°18′E, AM KS16598.

Holconia flindersi sp. nov.
(Figs 3, 9, 26, 36)

Types

Holotype: ♂, Wilmington, 32°39′S, 138°06′E, South Australia, March 1986, H. Kairl, SAMA N1989264.

Allotype: ♀, Warren Gorge, 32°11′S, 138°00′E, South Australia, 19. vi. 1988, G. and H. Kairl, SAMA N1988559.

Paratypes: ♀, Creekbed S of Woolshed Flat, Pichi Richi Pass, 32°28′S, 137°58′E, South Australia, 27. iv. 1987, D. Hirst, SAMA N1988544; ♂, same data, SAMA N1988545; ♀, Mambray Creek, 32°40′S, 138°02′E, South Australia, 24. iv. 1972, P. Martinson, SAMA N1988546.

Diagnosis

Most similar to *insignis,* separated in the male by the straighter palpal tibial apophysis and thicker more upright subembolic apophysis, and in the female by the longer parallel sided anterior section of the epigynum and shorter, narrower epigynal sclerite.

Holotype male

CL 10.32, CW 10.13. AL 9.80, AW 6.85.

Colour in alcohol: Carapace orange-brown with brown suffusion; caput darker orange-red. Brown-black setae form cross-banding posterior to caput; whitish setae in ocular area. Chelicerae reddish with yellowish upright setae; proximally with adpressed white setae. Maxillae and labium dark brown. Sternum yellow-brown; long greyish setae. Legs yellow-brown; blackish suffusion proventrally on femur I; short blackish setae at proximal ends of anterior femora and tibiae and around spine bases of femora prolaterally; white setae ventrally on femora, patellae and medially on tibiae. Abdomen yellowish with brown-black patches of setae forming transverse banded pattern, anterior band broken by yellowish streak; venter yellowish with orangish setae.

Eyes: AME 0.68. AME: ALE: PME: PLE = 1: 1.16: 0.69: 1.15. Interspaces: AME–AME 0.37, AME–ALE 0.38, PME–PME 1.38, PME–PLE 1.59, AME–PME 0.85, ALE–PLE 1.06. MOQ, aw: pw: l = 2.37: 2.76: 2.44. Width of clypeus to AME 0.29. Chelicerae: retromarginal teeth 5, similar to *insignis.* Labium: L 1.92, W 2.11. Sternum: L 5.53, W 4.59. Legs: anterior leg ratios I = 5.6, II = 6.0.

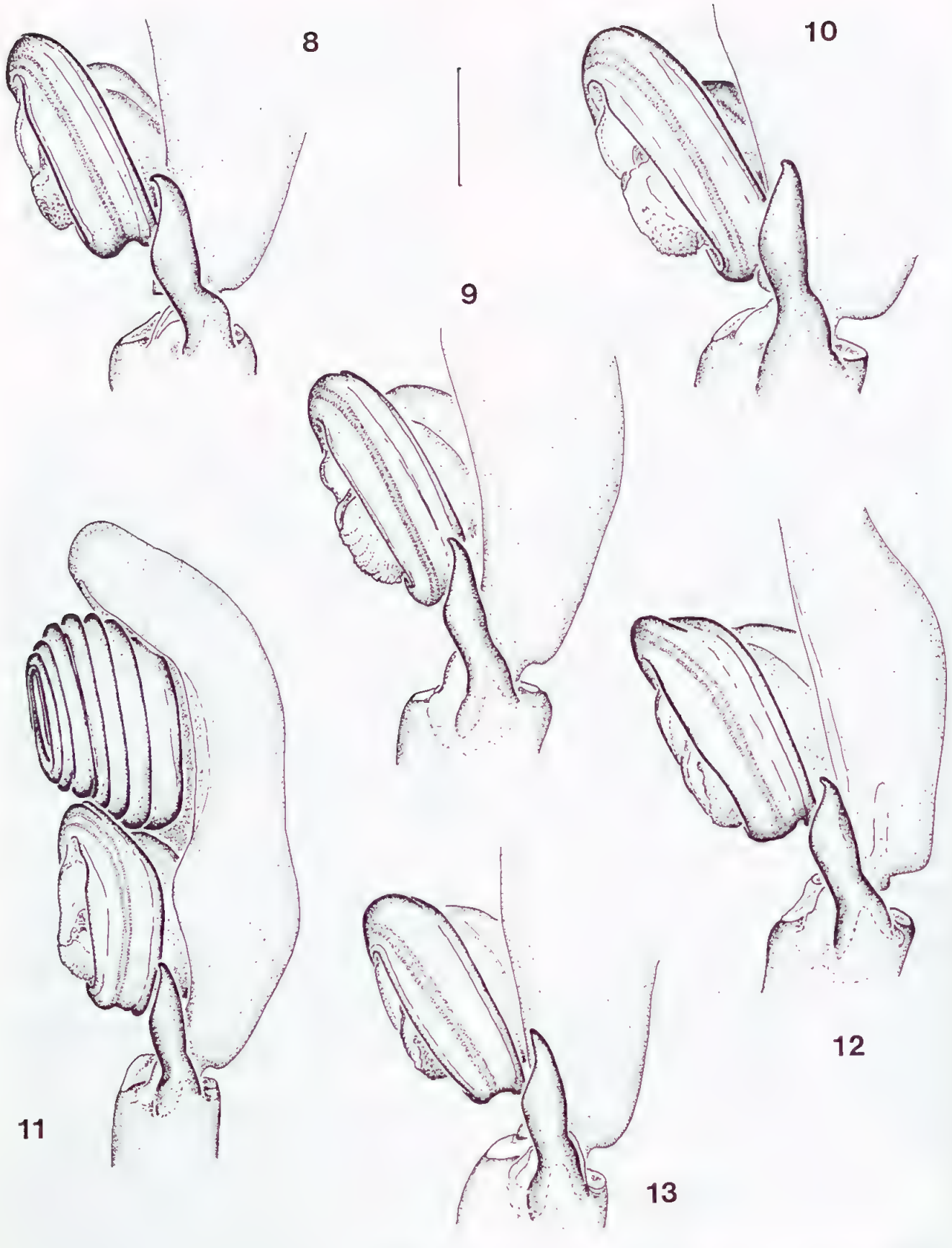
Palps: Tibial apophysis relatively straight. Embolus with 9¾ coils.

Allotype female (as male except as follows)

CL 12.35, CW 11.89. AL 14.95, AW 11.40.

Eyes: AME 0.74. AME: ALE: PME: PLE = 1: 1.16: 0.69: 1.16. Interspaces: AME–AME 0.39, AME–ALE 0.54, PME–PME 1.43, PME–PLE 1.72, AME–PME 0.91, ALE–PLE 1.22. MOQ, aw: pw: l = 2.39: 2.81: 2.54. Width of clypeus to AME 0.32. Labium: L 2.11, W 2.66. Sternum: L 6.53, W 5.30. Legs: anterior leg ratios I = 4.2, II = 5.0.

Epigynum: lateral sides somewhat parallel in anterior section for more than half length of fossa; epigynal sclerite moderately large, curved, extending less than ½ length of fossa.



FIGURES 8–13. *Holconia* males. 8–10, left palpal tibial apophysis and proximal portion of tarsus, retrolateral: 8, *H. immanis* (L. Koch), SAMA N1988515; 9, *H. flindersi,* holotype; 10, *H. murrayensis,* holotype. 11, left palpal tibial apophysis and whole tarsus of holotype *H. hirsuta* (L. Koch). 12–13, left palpal tibial apophysis and proximal portion of tarsus: 12, *H. colberti,* holotype; 13, *H. westralia,* holotype. Scale line 0.5mm.

Variation

Carapace length of males, 10.02–13.41, mean 11.43 (n=6). Embolus coils 9½ to 10. Carapace length of females, 11.72–14.78, mean 13.14 (n=20). Retromarginal cheliceral teeth usually 5, occasionally with 4 on one chelicera. Insemination duct coils about 9½ to 10.

Distribution and remarks

Occurs throughout the Flinders Ranges in South Australia, east to Broken Hill in New South Wales and Meringur in the north-west corner of Victoria (Fig. 36). It is frequently found near creeks on *Eucalyptus camaldulensis,* and often under *Casuarina* bark when away from waterways.

Other material examined

South Australia: ♀, Arcoona Creek, 30°28′S, 138°58′E, SAMA N1989265; ♀, Gadnina Station, *ca* 30°25′S, 139°05′E, SAMA N1988561; ♀, Hawker, 31°53′S, 138°25′E, SAMA N1988550; ♀, Holowilena Station, 31°53′S, 138°50′E, SAMA N1990275; ♀, Mambray Creek, 32°49′S, 138°05′E, SAMA N1988546; 2 ♂♂, penult. ♀, Melrose, 32°50′S, 138°11′E, SAMA N1988541–3; penult. ♀, Mooloolo, 30°59′S, 138°35′E, SAMA N1989266; juv., Mt Serle, 30°30′S, 138°54′E, SAMA N1989267; 2 ♀♀, 'North' (no exact locality), SAMA N1988497; ♂, Oakbank Station, 33°03′S, 140°35′E, SAMA N1988563; ♀, Orroroo, 32°44′S, 138°37′E, SAMA N1989268; ♀, Quorn, 32°21′S, 138°02′E, SAMA N1988549; ♂, ♀, Sturt Vale Station, 33°15′S, 140°02′E, SAMA N1988564–5; 8 ♀♀, penult. ♂, Wilpena, 31°30′S, 139°19′E, SAMA N1988552–60; ♂, ♀, Wirrealpa, 31°08′S, 138°58′E, SAMA N1988547–8; ♀, Yunta Dam, 32°37′S, 139°34′E, SAMA N1988562. **New South Wales:** ♀, Broken Hill, 31°58′S, 141°27′E, SAMA N1988521; ♀, same locality, AM KS5094; ♀, Wangumma, 34°09′S, 141°27′E, NMV. **Victoria:** ♂, Meringur, 34°24′S, 141°25′E, NMV.

Holconia murrayensis sp. nov.
(Figs 4, 10, 27–28, 36)

Types

Holotype: ♂, Mildura, 34°11′S, 142°10′E, Victoria, July 1955, Favalora, NMV K-0917.

Allotype: ♀, Nampoo Stn, Lake Victoria, 34°03′S, 141°10′E, SW New South Wales, under bark of red gum, 26. vi. 1967, R.R. Blackwood, NMV K-0918.

Paratypes: ♂, Balaklava Gliding Club Airfield, *ca* 2 km N of Whitwarta, 34°05′S, 138°20′E, South Australia, 28. i. 1989, A. Horton, SAMA N1989276; ♀, rafters of shack, few km S of Morgan on River Murray, 34°02′S, 139°40′E, South Australia, 28. xii. 1978, A. Edwards, SAMA N1988538.

Diagnosis

From *insignis* and *flindersi* by the male having a lower embolic coil number of 9 to less than 9½ and subembolic apophysis with slightly larger apex. Female with about 9 insemination duct coils.

Holotype male

CL 14.21, CW 13.92. AL 17.40, AW 11.25.

Colour in alcohol: Carapace reddish, lateral and posterior edges orange-red; caput dark reddish. Setae brownish medially; whitish adpressed setae on caput margins and posterior to ocular area; posterior half of caput with yellow-orangish adpressed setae. Chelicerae dark red-brown to blackish; setae yellow-brown. Maxillae and labium red-brown. Sternum orange-brown. Coxae yellow to orange-brown. Legs orange-red; dense white setae on femora dorsally, venter of patellae and tibiae. Abdomen yellowish with brown patches of setae divided anteriorly by yellow-brown streak. Venter yellow.

Eyes: AME 0.82. AME: ALE: PME: PLE = 1: 1.20: 0.71: 1.12. Interspaces: AME–AME 0.41, AME–ALE 0.51, PME–PME 1.34, PME–PLE 1.78, AME–PME 1, ALE–PLE 1.12. MOQ, aw: pw: l = 2.41: 2.76: 2.61. Width of clypeus to AME 0.37. Chelicerae: retromarginal teeth 5; distal and subdistal teeth separated by ½ tooth width. Labium: L 2.41, W 2.64. Sternum: L 7.42, W 6.28. Legs: anterior leg ratios I = 4.6, II = 5.5.

Palps: Subembolic apophysis broader distally and less curved than in *insignis.* Embolus with 9 coils.

Allotype female (as holotype male except as follows)

CL 14.35, CW 13.89. AL 16.25, AW 12.70.

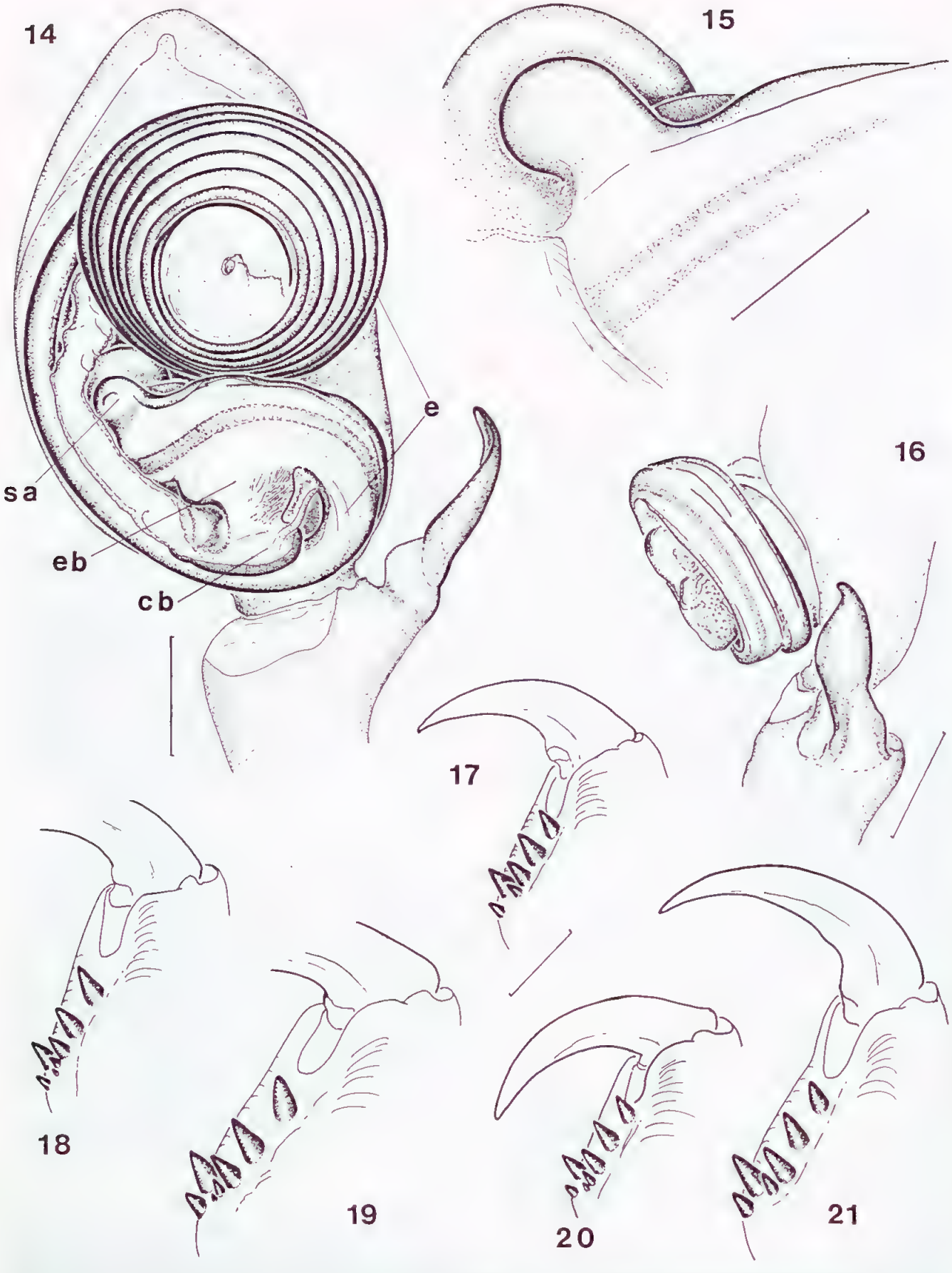
Colour in alcohol: Generally darker than male; legs reddish from patellae to metatarsi. Abdomen with anterior yellow-brown streak.

Eyes: AME 0.81. AME: ALE: PME: PLE = 1: 1.19: 0.69: 1.12. Interspaces: AME–AME 0.44, AME–ALE 0.60, PME–PME 1.44, PME–PLE 2.20, AME–PME 0.83, ALE–PLE 1.14. MOQ, aw: pw: l = 2.44: 2.83: 2.48. Width of clypeus to AME 0.43. Labium: L 2.47, W 2.87. Sternum: L 7.69, W 6.42. Legs: anterior leg ratios I = 4.1, II = 4.8.

Epigynum: epigynal sclerite begins midway along lateral side, broad near anterior (Fig. 27).

Variation

Carapace length of males, 11.62–12.49, mean 12.16 (n=3). Embolic coils 9, but a male from Unley Park has almost 9½. Carapace length of females, 13.08–16.22, mean 14.32 (n=19). Epigynal sclerite often rather broad anteriorly (Fig. 28). Insemination ducts with 9 coils. Usually with 5 retromarginal cheliceral teeth, much as in *insignis.* Colour generally darker than in *H. flindersi.*



FIGURES 14–21. *Holconia* males. 14–17, *H. nigrigularis* (Simon): 14, left palpal tibial apophysis and tarsus of syntype male ZMB 28.740, ventral; 15, embolic apophysis, SAMA N1988485; 16, left palpal tibial apophysis and proximal portion of tarsus, retrolateral, SAMA N1988498; 17, left retromarginal cheliceral teeth, SAMA N1988485. 18–21, left retromarginal cheliceral teeth: 18, *H. immanis* (L. Koch), SAMA N1988515; 19, *H. insignis* (Thorell), SAMA N1988522; 20, *H. hirsuta* (L. Koch), QM S12592; 21, *H. westralia,* holotype. e, embolus; eb, embolic base; cb, conductor base; sa, subembolic apophysis. Scale lines 0.5mm, 17–21 to same scale.

Distribution

Generally occurs along the Murray River and its tributaries in northern Victoria, southern New South Wales and South Australia (Fig. 36). In South Australia it is found along the Murray River from the Victorian border south to Murray Bridge, westwards along the River Marne and through the Barossa Valley to the Adelaide Plains in areas supporting *Eucalyptus camaldulensis,* and is known as far north as Whitwarta. In New South Wales it extends to Lake Cowal where it is sympatric with *H. insignis.* A penultimate specimen from Wilcannia is included in this taxon and indicates that the species is found along the Darling River system northwards to this locality. A female from Walwa in north-eastern Victoria is tentatively included until males from the area become available. Two populations appear to be isolated from the Murray River population. The first occurs on the floodplains and waterways of Lake Albacutya and Wyperfeld National Park in north-western Victoria while the second includes the Adelaide Plains and Barossa Valley west of longitude 139°00′.

Other material examined

Victoria: 2 ♀♀, Benalla, 36°33′S, 145°59′E, AM KS19950, AM KS19953; ♀, Gunbower, 35°58′S, 144°22′E, NMV; ♀, Kerang, 35°44′S, 143°55′E, NMV; juv., Lake Albacutya, *ca* 35°46′S, 142°03′E, AM KS19954; ♀, penult. ♂, Merbein, 34°10′S, 142°04′E, AM KS19971–2; ♀, Walwa, 35°58′S, 147°44′E, AM KS19956; 5 ♀♀, ♂, Wyperfeld, 35°32′S, 141°58′E, AM KS19944–7 (♂ = KS19945). **New South Wales:** juv., Balranald, 34°38′S, 143°34′E, SAMA N1988524; ♂, Lake Cowal, 33°36′S, 147°26′E, ANIC; ♀, Lake Mungo, 33°44′S, 143°02′E, SAMA N1989269; penult. ♀, Wilcannia, 31°34′S, 143°22′E, AM KS16657. **South Australia:** 3 ♀♀, Adelaide, 34°56′S, 138°36′E, SAMA N1988525–7; ♀, Bagot Well, 34°19′S, 138°59′E, SAMA N1988532; ♀, Blanchetown, 34°21′S, 139°37′E, SAMA N1988536; ♀, Chowilla, 34°01′S, 140°50′E, SAMA N1988540; penult. ♂, same locality, SAMA N1988405; 2 juv., Glen Osmond, Adelaide, SAMA N1989270–1; ♀, Henley Beach, Adelaide, SAMA N1988528; ♀, Hoyleton, 34°02′S, 138°34′E, SAMA N1988533; 2 ♀♀, Junction of River Marne and River Murray, 34°40′S, 139°19′E, SAMA N1988534–5; ♀, Lake Bonney, 34°13′S, 140°27′E, SAMA N1985143; ♀, Morgan, 34°02′S, 139°40′E, SAMA N1988537; ♀, same locality, SAMA N1988539; ♀, Murray Bridge, 35°07′S, 139°16′E, SAMA N1989272; ♀, Sandy Creek, 34°36′S, 138°49′E, SAMA N1988531; ♂, Unley Park, Adelaide, SAMA N1988529; ♀, Virginia, 34°40′S, 138°34′E, SAMA N1988530; juv., Woods Flat, 34°12′S, 139°38′E, SAMA N1989273.

Holconia immanis (L. Koch)
(Figs 1, 8, 18, 22–23, 35)

Delena immanis L. Koch, 1867: 208. Syntypes ♂, ♀, Brisbane, Queensland, NHMW, not located, presumed lost. One ♂ in NHMW [1884.I.454 (960)] with red 'T' on label but locality is Rockhampton, Queensland. Other material in NHMW seen (1882.II.38.) is not marked 'type' and does not match data given by Koch (1867). 'Syntypes', Brisbane, Queensland, ZMH (Mus. Godeffroy Nr 2285), may not be valid syntypes but material determined later by Koch (1875). One 'syntype' female examined.
Voconia immanis: L. Koch, 1875: 642, pl. 51, fig. 4.
Holconia immanis: Karsch, 1878: 792. Hirst, 1990: 18.
Isopeda immanis: Hogg, 1902: 432.
Mygale whitei Bonnet, 1957: 2994. Determination of 'white jointed spider', illustrated but not named by White, 1790. **New synonymy.**

Diagnosis

Abdomen dorsally with black anterior streak; venter with blackish badge markings. Chelicerae with retromarginal distal tooth largest. Male with relatively large subembolic apophysis; embolus usually with between 9¼ to 10 coils. Female epigynum relatively smaller than in other species, narrow anteriorly; lateral rims in anterior half usually diverging gradually or somewhat parallel to slightly broader posterior; epigynal sclerite large.

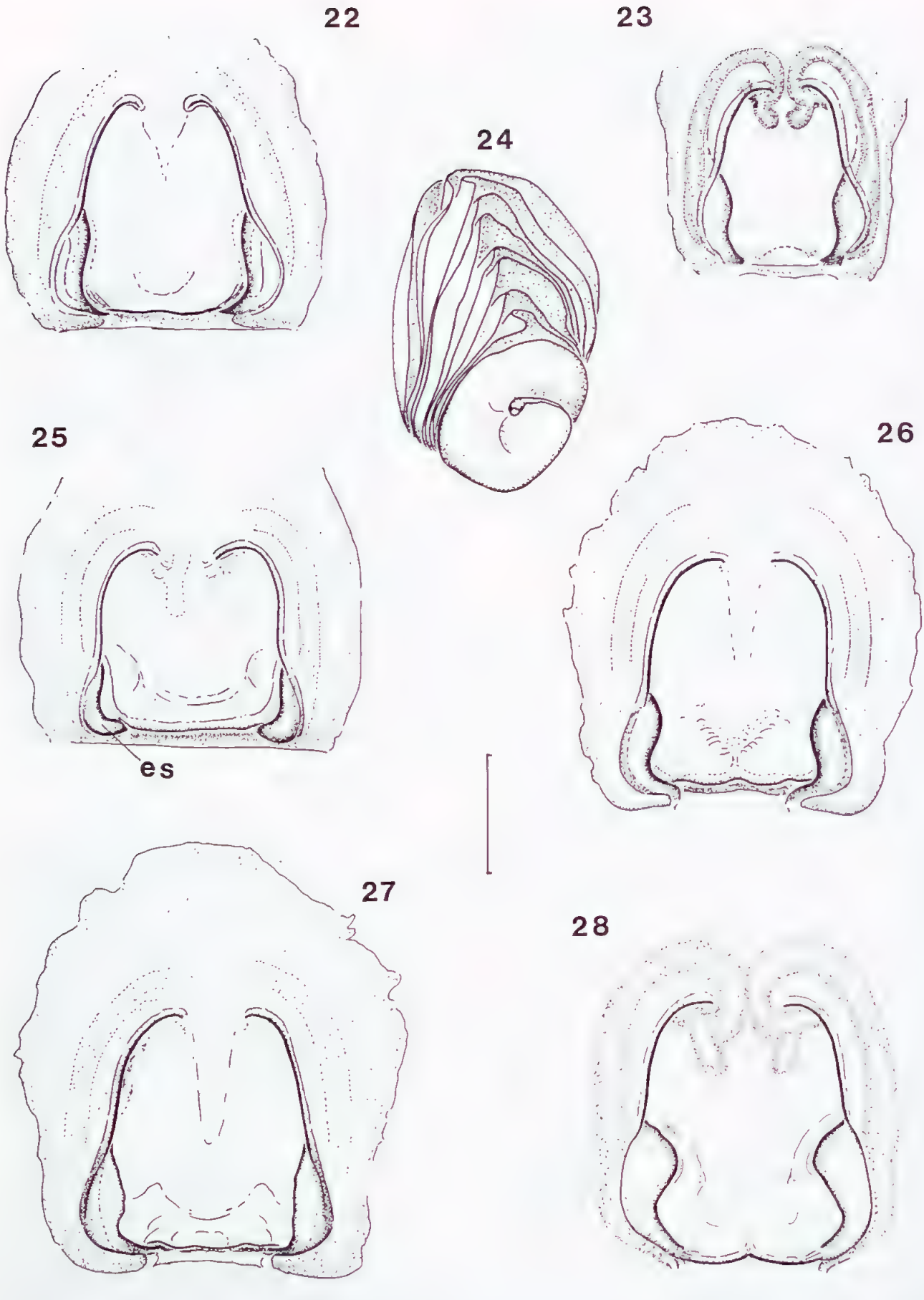
Female ZMH 2285

CL 13.5, CW 13.9. AL 20.5, AW 17.0.

Colour in alcohol: Carapace red-brown; orange-brown posterior and lateral margins. Setae brown-black medially; adpressed whitish setae around ocular area; long whitish setae on lateral margins. Chelicerae dark red-brown to blackish; long yellow-white setae. Maxillae and labium brown-black. Sternum dark red-brown; long blackish setae. Legs dark red-brown; venter of anterior tibiae with whitish setae medially. Abdomen yellowish with brownish suffusion giving rise to brown-black setae and forming a pattern dorsally and laterally; venter with blackish markings contained within 2 pale 'U' shaped lines.

Eyes: AME 0.90. AME: ALE: PME: PLE = 1: 1.11: 0.55: 0.66. Interspaces: AME–AME 0.44, AME–ALE 0.56, PME–PME 1.44, PME–PLE 1.78, AME–PME 0.77, ALE–PLE 1.11. MOQ, aw: pw: l = 2.33: 2.54: 2.22. Width of clypeus to AME 0.33. Chelicerae: retromarginal teeth 5; distal tooth largest. Sternum: L 7.4, W 6.0. Legs: anterior leg ratios, I = 4.4, II = 4.9.

Epigynum: (Fig. 22) lateral sides gradually diverging from relatively narrow anterior, posterior half broader; epigynal sclerite long, broad.



FIGURES 22–28. *Holconia* female epigyne. 22–23, *H. immanis* (L. Koch): 22, syntype ZMH 2285; 23, SAMA N1988510, spermathecae. 24, *H. insignis* (Thorell), SAMA N1988520, right insemination duct, dorsal. 25, *H. nigrigularis* (Simon), holotype *Isopeda simoni* Rainbow. 26, *H. flindersi,* allotype. 27–28, *H. murrayensis:* 27, allotype; 28, SAMA N1988536, spermathecae and epigynal sclerites. es, epigynal sclerite. Scale line 0.5mm.

Male SAMA N1988515 (as female except as follows) CL 10.54, CW 10.32. AL 12.80, AW 9.65.

Eyes: AME 0.74. AME: ALE: PME: PLE = 1: 1.03: 0.59: 0.96. Interspaces: AME–AME 0.34, AME–ALE 0.36, PME–PME 1.38, PME–PLE 1.50, AME–PME 0.72, ALE–PLE 0.81. MOQ, aw: pw: l = 2.34: 2.57: 2.27. Width of clypeus to AME 0.46. Labium: L 1.84, W 2.04. Sternum: L 5.56, W 4.79. Legs: anterior leg ratios I = 5.0, II = 5.9.

Palps: Subembolic apophysis large, knob-like. Embolic coils slightly greater than 9¾.

Variation

Carapace length of males, 10.64–14.21, mean 12.45 (n=3). Embolic coils of 28 males examined showed a range greater than one complete coil, most had 9½ coils (n=16), others were with 9¾ (n=5), 10 to 10½ (n=4) and 9 to 9¼ (n=2). Carapace length of females, 13.38–15.02, mean 14.37 (n=6). Insemination duct coils 10. Epigynum occasionally narrow, having somewhat parallel lateral rims in anterior half. Sternum occasionally dark reddish-brown.

Distribution

Occurs along the east coast of Australia from Thursday Island, Queensland, southwards to Nowa Nowa, Victoria. It is largely restricted to the eastern side of the Great Dividing Range (Fig. 35).

Other material examined

Queensland: ♂, Atherton, 17°16′S, 145°29′E, QM S12604; ♀, same locality, AM KS19702; ♀, Boonah, 28°00′S, 152°41′E, QM S12605; ♂, Brisbane, QM S12606; ♀, Byfield, 22°51′S, 150°39′E, AM KS19723; ♀, Cairns, 16°55′S, 145°46′E, QM S12607; ♀, same locality, AM KS19700; ♀, Calliope, 24°00′S, 151°12′E, QM S12608; ♀, Cape Hillsborough, 20°54′S, 149°03′E, QM S12609; 2 ♂♂, Closeburn, Brisbane, 27°20′S, 152°52′E, QM S12610–11; 2 ♀♀, Coolum, 26°33′S, 153°05′E, NMV; ♀, Cunninghams Gap, 28°03′S, 152°24′E, QM S12613; 2 ♀♀, Dunk Island, 17°57′S, 146°09′E, SAMA N1988513–4; ♀, Eumundi, 26°29′S, 152°57′E, NMV; ♂, Eurambala, Brisbane, QM S12614; ♂, Ferny Hills, Brisbane, QM S12615; ♀, Fitzroy Island, 16°56′S, 146°00′E, AM KS19708; 2 ♀♀, Fraser Island, 25°33′S, 152°59′E, AM KS19698, AM KS19701; ♂, Gin Gin, 25°00′S, 151°57′E, QM S12616; ♂, Gumdale, Brisbane, QM S12617; ♀, Gympie, 26°11′S, 152°40′E, QM S12618; juv., Herberton, 17°23′S, 145°23′E, AM KS19645; ♂, Highvale, Brisbane, QM S12619; ♂, penult. ♀, Holloway Beach, 16°50′S, 145°44′E, SAMA N1988515–6; ♀, Jimboomba, 27°50′S, 153°02′E, QM S12620; ♀, Koongal, 23°23′S, 150°33′E, AM KS16630; ♀, Logan River, 28°16′S, 152°44′E, SAMA N1988512; ♂, Marlaybrook, 26°54′S, 151°36′E, QM S12621; ♀, North Pine River, 27°16′S, 152°55′E, QM S12622; ♂, Nundah, Brisbane, 27°25′S, 153°03′E, QM S12623; 4 ♂♂, Percy Island, 21°42′S, 150°20′E, QM S12624; ♂, Proserpine, 20°24′S, 148°35′E, QM S12625; ♂, Redbank, 27°36′S, 152°52′E, QM S12626; ♀, Rockhampton, 23°22′S, 150°32′E, AM KS16659; juv., same locality, AM KS19644; ♂, Scarborough, 27°12′S, 153°07′E, QM S12627; ♂, Stradbroke Island, *ca* 27°50′S, 153°25′E, NMV; 2 ♂♂, Thursday Island, 10°35′S, 142°13′E, QM S12628; juv., Warwick, 28°13′S, 152°02′E, AM KS20501. **New South Wales:** 2 ♂♂, juv., Brooklana, 30°16′S, 152°53′E, AM KS19706; 2 ♂♂, Brunswick Heads, 28°32′S, 153°33′E, SAMA N1988508–9; ♀, Charlestown, 32°58′S, 151°41′E, AM KS19707; ♀, Congarinni, 30°44′S, 152°52′E, AM KS17879; ♀, Coraki, 29°00′S, 153°17′E, AM KS16535; 2 ♂♂, Cudgen, 28°16′S, 153°33′E, QM S12612; ♂, Engadine, Sydney, AM KS16607; ♀, Gladesville, Sydney, AM KS19655; ♀, Glenhaven, 31°11′S, 151°58′E, AM KS19697; ♀, Goonengerry, 28°37′S, 153°26′E, AM KS19717; ♀, Gordon, Sydney, AM KS19704; juv., Gosford, 33°26′S, 151°20′E, AM KS19673; ♀, Grafton, 29°41′S, 152°56′E, NMV; ♀, same locality, AM KS17183; juv., Macksville, 30°43′S, 152°55′E, AM KS18271; ♀, Mona Vale, Sydney, AM KS18390; ♀, Mooney Mooney, 33°31′S, 151°12′E, AM KS19674; penult. ♂, Mullumbimby, 28°33′S, 153°30′E, AM KS19716; ♀, Mumbulla, *ca* 36°33′S, 149°52′E, AM KS19715; juv., Nadgee, 37°28′S, 149°58′E, AM KS19705; ♀, Nelligen, 35°39′S, 150°08′E, AM KS16595; ♂, 2 juv., Nowra, 34°53′S, 150°36′E, SAMA N1988505–7; ♀, Pennant Hills, Sydney, AM KS19672; ♂, Stotts Island, Tweed River, 28°16′S, 153°30′E, QM S12593; juv., Taree, 31°54′S, 152°29′E, AM KS16680; ♂, Tooloom, 28°37′S, 152°25′E, AM KS16605; 2 juv., same locality, AM KS16631; ♀, Turramurra, 31°20′S, 150°59′E, AM KS19699. **Victoria:** ♂, 3 ♀♀, Noorinbee, 37°31′S, 149°10′E, AM KS19948, AM KS19719–21; ♀, Nowa Nowa, 37°44′S, 148°06′E, AM KS19718.

The *hirsuta* Group

Two species, *H. hirsuta* and *H. neglecta,* differ from the *insignis* group only in the lower number of coils in the embolus of the male and spermathecae of the female, the retromarginal cheliceral teeth being closer to the fang base and the female epigynum relatively broader posteriorly. The group has a northern distribution.

Holconia hirsuta (L. Koch)
(Figs 5, 11, 20, 29–30, 36)

Isopeda hirsuta L. Koch, 1875: 693, pl. 59, fig. 1. Holotype ♂, Bowen [20°01′S, 148°15′E],

FIGURES 29–34. *Holconia* female epigyne. 29–30, *H. hirsuta* (L. Koch): 29, holotype *H. subdola* Thorell; 30, SAMA N1988517, spermathecae. 31, *H. neglecta* holotype, spermathecae. 32, *H. westralia* allotype, spermathecae. 33–34, *H. colberti:* 32, allotype; 33, paratype NMV K-0922, spermathecae. Scale line 0.5mm.

Queensland, ZMH (Mus. Godeffroy Nr 11013), left palp examined (whole specimen in poor condition, not able to be sent).
Holconia hirsuta: Hirst, 1990: 18.
Holconia subdola Thorell, 1881: 304. Holotype, ♀, Somerset [10°45′S, 142°35′E], Queensland, 1875, L.M. D'Albertis. MCG, examined. **New synonymy.**

Diagnosis

From other species by the male having only 7½ to 8 embolic coils (except *H. neglecta* in which the unknown male is also expected to have a similar coil number), a shorter palpal tibial apophysis and small subembolic apophysis. From *H. neglecta* in the female by the epigynum lateral rims being somewhat parallel in anterior half then diverging sharply to broad posterior half; epigynal sclerite small and relatively short.

Female (holotype *H. subdola* Thorell)

CL 11.8, CW 11.1. AL 12.5, AW 9.0.

Colour in alcohol: Carapace and legs dark reddish-brown; caput and striae darker. Abdomen yellow-brown with patches of orange setae.

Eyes: AME 0.78. AME: ALE: PME: PLE = 1: 1.18: 0.62: 1. Interspaces: AME-AME 0.44, AME-ALE 0.51, PME-PME 1.36, PME-PLE 1.32, AME-PME 0.74, ALE-PLE 1.10. MOQ, aw: pw: l = 2.33: 2.56: 2.31. Width of clypeus to AME 0.36. Chelicerae: retromarginal teeth 5; distal tooth subequal to subdistal tooth. Labium: L 1.96, W 2.42. Sternum: L 6.20, W 5.38. Legs: anterior leg ratios I = 3.7, II = 4.5.

Epigynum: (Fig. 29) lateral rims diverging sharply mid-length to broad posterior; epigynal sclerite small, relatively short.

Male QM S12592

CL 9.32, CW 9.08. AL 10.65, AW 6.75.

Colour in alcohol: Carapace orange-red, suffused with black; posterior margin yellowish; caput reddish. Chelicerae maxillae and labium reddish. Sternum and coxae orange. Legs yellow to orange-red. Abdomen yellowish-brown with faint mottled pattern and dorsal anterior pale streak of brown and orange setae; venter yellowish with brown suffusion.

Eyes: AME 0.66. AME: ALE: PME: PLE = 1: 1.15: 0.69: 1.14. Interspaces: AME-AME 0.27, AME-ALE 0.30, PME-PME 1.18, PME-PLE 1.41, AME-PME 0.82, ALE-PLE 0.85. MOQ, aw: pw: l = 2.27: 2.59: 2.30. Width of clypeus to AME 0.27. Labium: L 1.67, W 1.83. Sternum: L 5.01, W 4.41. Legs: anterior leg ratios I = 4.7, II not available (legs missing).

Palps: Embolus with 8 coils. Holotype with 7½ coils (Fig. 11).

Variation

Carapace length of male QM S12603, 11.3. Embolus with 7¾ coils. Carapace length of females, 11.48–14.50, mean 13.22 (n=9). Vulva of SAMA N1988517 with 8 insemination duct coils. Cheliceral teeth usually with a space subequal to a tooth width between median and subdistal teeth.

Distribution

Occurs in north-east Queensland from Cape York south to Townsville, westwards to Hughenden (Fig. 36). A juvenile from Floraville Station near Burketown and a female from Burketown are tentatively included although the epigynum shape of the female is not characteristic.

Other material examined

Queensland: ♀, Burketown, 17°45′S, 139°33′E, AM KS16643; ♀, Cape Pallarenda, 19°11′S, 146°46′E, QM S12599; ♀, Chillagoe, 17°09′S, 144°31′E, QM S12600; ♀, Davies Creek, 16°55′S, 145°32′E, QM S12601; ♂, Finch Hatton, 21°09′S, 148°38′E, QM S12592; penult. ♂, Hughenden, 20°51′S, 144°12′E, QM S12602; juv., Floraville Stn 18°14′S, 139°52′E, QM; juv., Mingela, 19°53′S, 146°38′E, QM; ♂, 3 ♀♀, 3 juv., Mt Molloy, 16°41′S, 145°20′E, QM S12603; juv., Townsville, 19°16′S, 146°49′E, SAMA N1988518; ♀, Wenlock Goldfield, 13°05′S, 142°57′E, SAMA N1988517.

Holcönia neglecta sp. nov.
(Figs 31, 36)

Types

Holotype: ♀, on snappy gum, 50 km SW Wave Hill, 17°27′S, 130°50′E, Northern Territory, 31. viii. 1981, H. Parnaby, AM KS18913.

Paratype: ♀, same data as holotype but 2130 hours, riverside vegetation, AM KS19957.

Diagnosis

Males unknown. Females diagnosed by the epigynum with lateral rims diverging gradually to broad posterior margin; epigynal sclerite broad at first then rapidly narrowing. Vulva with insemination ducts coiled 8 times.

Holotype female

CL 12.85, CW 12.42. AL 14.50, AW 9.80.

Colour in alcohol: Carapace orange-red; caput reddish with white adpressed setae, dense in ocular area; sparse black-brown setae form transverse band in region of fovea, Chelicerae dark reddish; yellow-brown setae and adpressed white setae. Maxillae and labium red-brown. Sternum orange-brown; sparse upright yellow-brown and adpressed white setae.

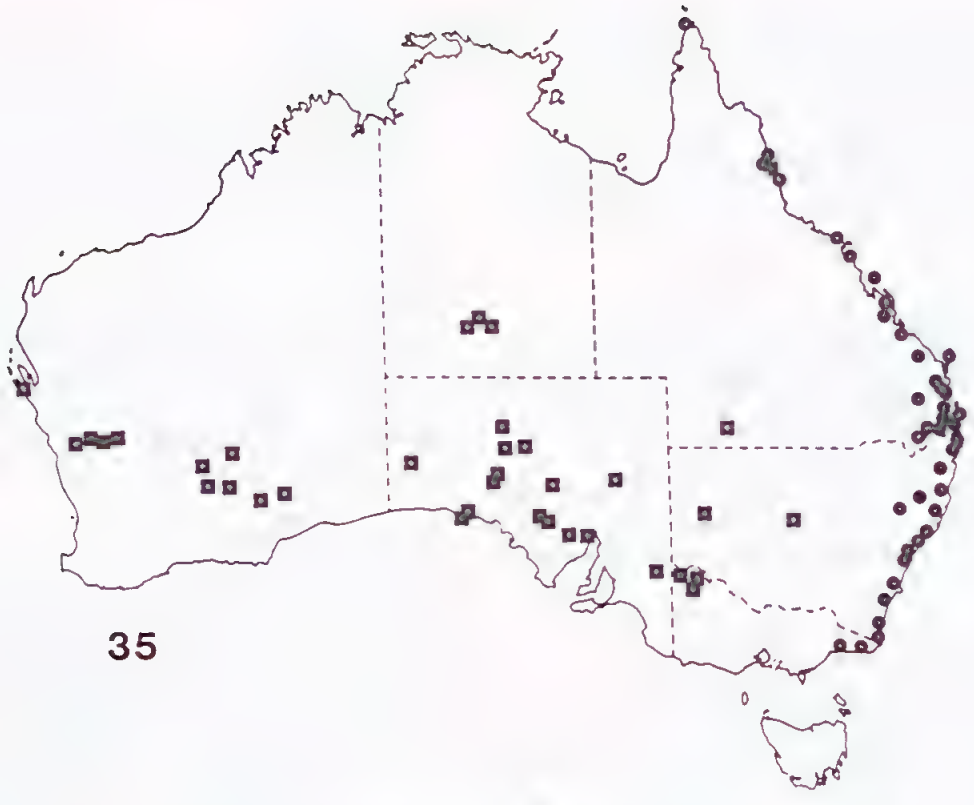


FIGURE 35. Distribution of *Holconia nigrigularis* (Simon) ■ and *H. immanis* (L. Koch) ●.

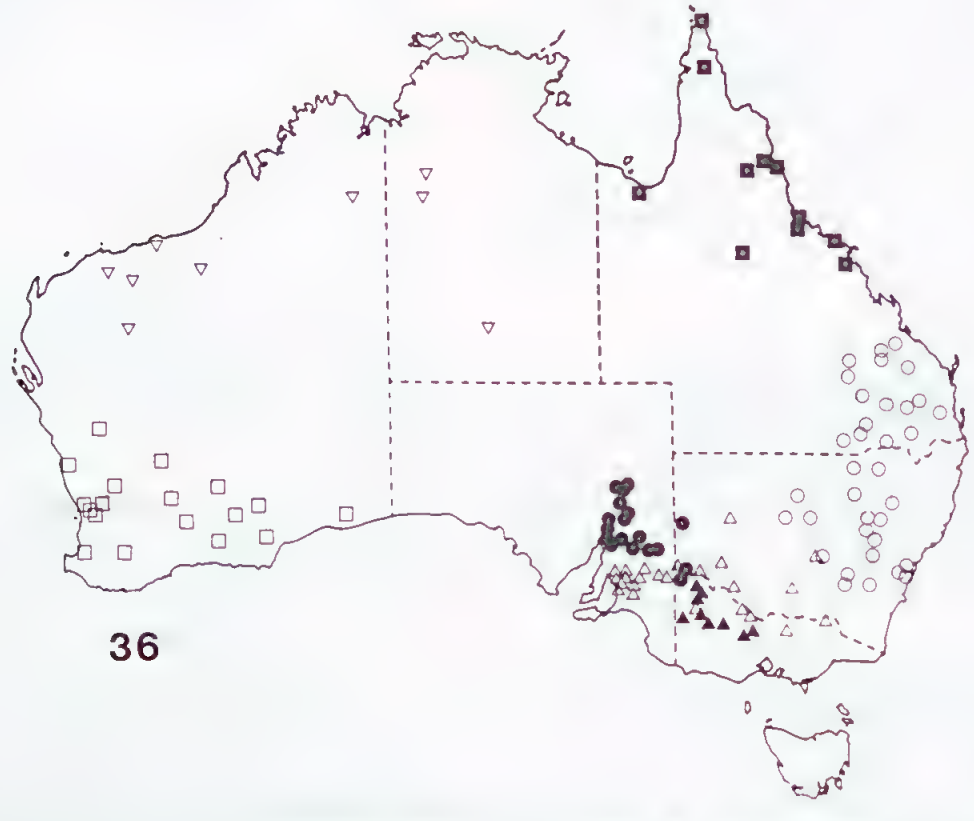


FIGURE 36. Distribution of *Holconia insignis* (Thorell) ○, *H. flindersi* ●, *H. murrayensis* Δ, *H. hirsuta* (L. Koch) ■, *H. neglecta* ▽, *H. colberti* ▲ and *H. westralia* □.

Coxae yellow-brown. Legs with yellow-brown femora, anterior pairs red-brown distally with blackish suffusion; remaining segments red-brown; tibiae with blackish suffusion at ends. White setae ventrally on femora, patellae and medially on tibiae. Abdomen yellowish with yellow anterior streak; orange-brown setae forming a spotted pattern; venter yellow.

Eyes: AME 0.78. AME: ALE: PME: PLE = 1: 1.09: 0.64: 1.10. Interspaces: AME–AME 0.50, AME–ALE 0.58, PME–PME 1.68, PME–PLE 1.85, AME–PME 0.79, ALE–PLE 1.23. MOQ, aw: pw: l = 2.50: 2.96: 2.33. Width of clypeus to AME 0.32. Chelicerae: retromarginal teeth 5; distal tooth curved towards anterior, subequal to subdistal tooth. Labium: L 2.26, W 2.68. Sternum: L 7.12, W 5.73. Legs: anterior leg ratios I = 3.8, II = 4.3.

Epigynum: (Fig. 31) lateral sides diverging to posterior; epigynal sclerite large, curved, narrowing posteriorly.

Variation

Carapace length of paratype, 12.54.

Distribution and remarks

Northern Territory and northern Western Australia (Fig. 36). A female from Alice Springs is tentatively considered to belong to this taxon. A juvenile from Mitchell Plateau is probably not conspecific as it has a reddish-brown sternum with blackish suffusion anteriorly and a yellow-brown posterior margin. The abdomen is not as distinctly marked dorsally while the venter resembles that of *H. immanis* but is orangish with orange-brown contained within whitish 'U' shaped markings.

Etymology

The specific epithet reflects the paucity of mature specimens available for study and the consequent incomplete treatment of this species.

Other material examined

Northern Territory: ♀, Alice Springs, 23°42′S, 133°52′E, SAMA N1988519; 2 juv., Hooker Creek, 18°20′S, 130°38′E, AM KS18912, AM KS20502. **Western Australia:** juv., Halls Creek, 18°14′S, 127°40′E, SAMA N1989274; penult. ♂, De Grey River, 20°20′S, 119°13′E, WAM 88/871; juv., Hooley, 21°53′S, 118°13′E, WAM 88/881; juv., Lower Carawine Gorge, 21°29′S, 121°02′E, WAM 88/1822; penult. ♂, Millstream, 21°35′S, 117°04′E, WAM 88/898; juv., Mitchell Plateau, 14°49′S, 125°50′E, WAM 88/2014; penult. ♂, Mt Vernon, 24°09′S, 118°02′E, WAM 88/906.

The *colberti* Group

The two species, *H. colberti* and *H. westralia*, have a slightly higher carapace, clypeus width about half diameter of AME and four retromarginal cheliceral teeth. The male embolus is coiled between 10 to 11⅔ times. The group has a southern distribution.

Holconia colberti sp. nov.
(Figs 7, 12, 33–34, 36)

Types

Holotype: ♂, site 59, drift fence pitfall trap, 14.4 km SE Walpeup, 35°11′S, 142°11′E, Victoria, Jan. 1987, A.L. Yen, NMV K-0919.

Allotype: ♀, Lake Hattah, 34°44′S, 142°21′E, Mallee, Victoria, Oct. 1915, J.E. Dixon, NMV K-0920.

Paratypes: ♀, same data as allotype, NMV K-0921; ♀, Kewell, 36°31′S, 142°21′E, Victoria, Nov. 1892, J.A. Kershaw, NMV K-0922.

Diagnosis

Carapace high but flattish above. Male embolus with 11¼ to 11⅔ coils; subembolic apophysis broad. Females with relatively short, broad epigynal sclerite; insemination ducts coiled 11 times.

Holotype male

CL 10.95, CW 10.42. AL 13.50, AW 8.65.

Colour in alcohol: Carapace reddish-brown, darker suffusion; lateral eye surrounds blackish mesally. Blackish setae on carapace; some white setae in ocular area. Chelicerae dark red-brown to blackish; long yellowish and short recumbent setae. Maxillae and labium as chelicerae. Sternum orange-yellow. Coxae yellowish. Legs red-brown; femora paler with blackish suffusion at base proventrally; spine bases darker red-brown; setae blackish; sparse white recumbent setae on femora, patellae and tibiae, mostly proventral. Abdomen dorsally yellowish with brown markings; anterior median streak indistinct; venter pale yellow.

Eyes: AME 0.64. AME: ALE: PME: PLE = 1: 1.22: 0.75: 1.19. Interspaces: AME–AME 0.56, AME–ALE 0.38, PME–PME 1.47, PME–PLE 1.75, AME–PME 1.16, ALE–PLE 1.25. MOQ, aw: pw: l = 2.56: 2.97: 1.31. Width of clypeus to AME 0.52. Chelicerae: retromarginal teeth 4, closely spaced; distal subequal, angled more anteriorly. Labium: L 1.78, W 2.14. Sternum: L 5.58, W 4.99. Legs: anterior leg ratios I = 4.3, II = 4.9.

Palps: Embolic base relatively large; subembolic apophysis broader than in other species (Fig. 7). Embolus coiled almost 11⅔ times.

Allotype female (as male except as follows)

CL 12.95, CW 12.65. AL 17.00, AW 12.50.

Colour in alcohol: dark red-brown.

Eyes: AME 0.72. AME: ALE: PME: PLE = 1: 1.28: 0.67: 1.15. Interspaces AME-AME 0.55, AME-ALE 0.61, PME-PME 1.61, PME-PLE 2.06, AME-PME 1, ALE-PLE 1.36. MOQ, aw: pw: l = 2.56: 2.94: 2.64. Width of clypeus to AME 0.54. Labium: L 2.36, W 2.65. Sternum: L 6.74, W 5.68. Legs: anterior leg ratios I = 4.0, II = 4.7.

Epigynum: (Fig. 33) not much broader posteriorly; epigynal sclerite relatively short.

Variation

Carapace length of males, 10.56–12.65, mean 11.53 (n=3; embolus of 2 specimens coiled 11¼ times and 1 coiled 11½ times). Carapace length of females, 11.02–14.89, mean 12.70 (n=16). Vulva of paratype NMV K-0922 (Fig. 34) with sharply curved spermathecal sacs and 11 insemination coils. Two specimens have 5 retromarginal teeth on either left or right chelicera and a further two are with 5 on both chelicera. One male has only 3 teeth on the left chelicera. Leg II may be relatively shorter than in other species and the anterior legs appear more robust.

Distribution

Western Victoria from Broughton eastwards to Elmore, and Hattah Lakes southwards to at least Marong near Bendigo (Fig. 36). One female from Melbourne may have been transported in with timber.

Etymology

Named after the owners of a property SW of Broughton, Victoria, where I had the opportunity to collect several specimens.

Other material examined

Victoria: 2 ♂♂, 8 ♀♀, penult. ♂, SW Broughton, 36°12′S, 141°19′E, SAMA N1989605-15, juv., same locality, SAMA N1989275; ♂, 3 ♀♀, Charlton, 36°16′S, 143°21′E, AM KS19949; ♀, Elizabeth St, Melbourne, NMV; juv., Elmore, 36°30′S, 144°37′E, SAMA N1990273; ♀, Hattah Lakes, 34°44′S, 142°21′E, AM KS19951; penult. ♀, juv., same data as allotype, NMV; juv., Kewell, same data as paratype, NMV; penult. ♂, juv., mallee scrub, western district, Feb. 1884, NMV; 2 ♀♀, Marong, 36°44′S, 144°08′E, AM KS19952, AM KS19955; juv., Ouyen, 35°04′S, 142°19′E, NMV; ♀, juv., Warracknabeal, 36°15′S, 142°24′E, NMV.

Holconia westralia sp. nov.
(Figs 6, 13, 21, 32, 36)

Types

Holotype: ♂, Salmon Gums Pre-Primary School, 32°59′S, 121°39′E, Western Australia, 11. iii. 1983, N. Contreau, WAM 86/688.

Allotype: ♀, on log, WL South Camp, Woodline, 31°54′S, 122°24′E, Western Australia, WAM Goldfields Survey, Aug. 1980, W.F. Humphreys *et al.*, WAM 88/926.

Paratypes: ♂, Yellowdine, 31°18′S, 119°39′E, Western Australia, 6. xi. 1970, W.H. Butler, WAM 86/683; ♀, N of Lake Hope, 32°16′S, 120°16′E, Western Australia, 26. ix. 1978, Barron and Harold, WAM 88/890.

Diagnosis

Carapace slightly convex; chelicera usually with 4 retromarginal teeth. Male embolus with 10 to 10¼ coils. Female with long narrow epigynal sclerite.

Holotype male

CL 11.82, CW 11.01. AL 11.95, AW 8.25.

Colour in alcohol: Carapace orange-red, posterior and laterals paler; caput dark red. Chelicerae dark red-brown; yellow setae; some adpressed white setae proximally. Maxillae and labium dark red-brown. Sternum yellow-brown; brownish and white setae. Coxae yellowish. Anterior legs orange-red, posterior legs yellow-red; metatarsi and tarsi reddish. Setae bases dark coloured; numerous clumps of whitish setae dorsally. Venter of patellae and tibiae medially with long whitish setae. Abdomen yellow-brown with darker patches; 3 indistinct pairs of blackish spots; anterior streak with orange-red setae; venter yellowish; yellow-brown setae.

Eyes: AME 0.71. AME: ALE: PME: PLE = 1: 1.24: 0.73: 1.07. Interspaces: AME-AME 0.41, AME-ALE 0.35, PME-PME 1.15, PME-PLE 1.30, AME-PME 0.86, ALE-PLE 0.87. MOQ, aw: pw: l =2.41: 2.62: 2.56. Width of clypeus to AME 0.51. Chelicerae: retromarginal teeth 4 consisting of a small basal tooth and 3 well-spaced larger teeth of which the distal is smallest (Fig. 21). Labium: L 1.94, W 2.24. Sternum: L 5.96, W 5.18. Legs: anterior leg ratios I = 4.5, II = 5.3.

Palps: Tibial apophysis barely curved inwards at apex. Subembolic apophysis small, base inclined (Fig. 6). Embolus with 10 coils.

Allotype female (as holotype except as follows)

CL 11.93, CW 11.18. AL 14.45, AW 11.65.

Eyes: AME 0.71. AME: ALE: PME: PLE = 1: 1.20: 0.69: 1.10. Interspaces: AME-AME 0.42, AME-ALE 0.38, PME-PME 1.29, PME-PLE 1.61, AME-PME 0.92, ALE-PLE 1.01. MOQ, aw: pw: l = 2.42: 2.68: 2.44. Width of clypeus to AME 0.45. Chelicerae: right chelicera with additional small basal tooth on retromargin; teeth more closely spaced. Labium: L 1.96, W 2.38. Sternum: L 6.09, W 5.38. Legs: anterior leg ratios I = 3.9, II = 4.5.

Epigynum: (Fig. 31) epigynal sclerite long, narrow.

Variation

Carapace length of males, 9.80–11.65, mean 10.91 (n = 7). Embolus coils 10 to 10¼. Carapace length of females, 11.55–13.52, mean 12.53 (n = 11). Most often with 4 retromarginal cheliceral teeth, rarely with 5 on both chelicera.

Distribution

Semi-arid and areas of moderate rainfall in south-west Western Australia (Fig. 36).

Other material examined

Western Australia: ♀, Booanya, 32°46′S, 123°26′E, NMV; 2 juv., same locality, AM KS19647, AM KS19658; 6 juv., Buningonia Spring, *ca* 31°25′S, 123°34′E, WAM 88/2047–50, WAM 88/2052–3; juv., Cottesloe, Perth, WAM 12/5132; 2 ♂♂, 2 ♀♀, 3 juv., Darlington, 31°55′S, 116°04′E, WAM 86/642–4, WAM 88/1833–4, WAM 88/1836–7; juv., Diemals, 29°40′S, 119°18′E, WAM 88/872; ♀, Fremantle, Perth, WAM 88/1845; juv., Glen Forrest, 31°55′S, 116°06′E, WAM 88/1533; ♀, Gooseberry Hill, 31°57′S, 116°03′E, WAM 88/1850; ♀, Hovea, 31°52′S, 116°06′E, WAM 88/1856; 2 ♂♂, Kalamunda, 31°58′S, 116°03′E, WAM 88/1858–9; ♂, Kalgoorlie, 30°45′S, 121°28′E, NMV; 2 ♀♀, 1 juv., Katanning, 33°41′S, 117°33′E, WAM 88/884–6; juv., Lake Indoon, 29°52′S, 115°09′E, WAM 88/2440; juv., Madura, 31°53′S, 127°03′E, WAM 88/894; juv., Mahogany Creek, 31°54′S, 116°08′E, WAM 88/1871; ♀, Midland Junction, Perth, WAM 88/897; juv., Mt Pleasant, Perth, WAM 88/1881; ♂, Parkerville, 31°53′S, 116°08′E, WAM 86/667; ♀, Pearce, 31°40′S, 116°01′E, WAM 88/915; ♂, Perth, 31°57′S, 115°51′E, WAM 86/668; ♀, Toodyay, 31°33′S, 116°28′E, WAM 88/916; 2 juv., Walk Walkin, 30°49′S, 117°19′E, WAM 40/1075–6; juv., Wanneroo, 31°45′S, 115°48′E, WAM 88/1772; penult. ♂, Wellard, 32°16′S, 115°51′E, WAM 88/1919; ♀, Wembley, Perth, WAM 88/1921; 5 juv., Woodline, 31°53′S, 122°27′E, WAM 88/2090, WAM 88/2099–100, WAM 88/2104; juv., Wundowie, 31°46′S, 116°23′E, WAM 88/931; juv., Yalgoo, 28°21′S, 116°41′E, WAM 26/683.

The *nigrigularis* Group

This 'group' consists of only one species, *H. nigrigularis,* which has a flatter carapace, subembolic apophysis of the male not connected directly to the tegulum, female with broad epigynum and relatively straight spermathecal sacs. It occurs in arid to semi-arid areas.

Holconia nigrigularis (Simon)
(Figs 14–17, 25, 35)

Isopoda nigrigularis Simon, 1908: 438. Syntype ♂, Stat[ion]. 70, Tamala [26°42′S, 113°43′E], Western Australia, ZMB 28.740, examined. Simon (1908) also lists Northampton, Western Australia, as a locality record but without giving further details of any specimen. Whereabouts of that specimen is unknown.

Isopoda woodwardi Simon, 1908: 437. Holotype ♀, Stat[ion]. 93, Kalgoorlie [30°45′S, 121°28′E], Western Australia, ZMB 28.739, examined.

Isopeda simoni Rainbow, 1911: 234. Nom. nov. for *Isopeda woodwardi* Simon, 1908, homonym of *Isopeda woodwardi* Hogg, 1902. **New synonymy.**

Holconia nigrigularis: Hirst, 1990: 18.

Diagnosis

H. nigrigularis is separated from other species by the flatter carapace, 8–9 times longer than high, depressed medially. Clypeus width about ⅛ diameter of AME. Abdomen without a distinct pattern but with grey-black venter. Chelicera usually with 4 retromarginal teeth. Male embolic base with prodistal low rounded subembolic apophysis not fixed to tegulum; striations near embolus origin; embolus usually with 9 to 9¼ coils but may have a half coil more or less. Female epigynum broad, rounded. Epigynal sclerite narrow; short to moderate length. Spermathecal sacs straight to gently curved.

Holotype male

CL 7.7, CW 7.5. AW 9.0, AL 5.5.

Colour in alcohol: Carapace reddish-yellow, striae reddish; white and brown-black adpressed setae. Chelicerae reddish with erect yellow-white setae. Maxillae and labium orange-red brown. Sternum yellowish medially; margins and anterior portion yellow-brown. Palps yellowish; cymbium yellow-brown. Coxae cream-yellow. Legs orange-yellow. Abdomen dorsally yellowish with clusters of reddish-brown or orange setae forming a vague pattern; venter with large ill-defined grey-black patch.

Eyes: AME 0.54. AME: ALE: PME: PLE = 1: 1.11: 0.51: 1. Interspaces: AME–AME 0.25, AME–ALE 0.32, PME–PME 1.33, PME–PLE 1.50, AME–PME 0.74, ALE–PLE 0.97. MOQ, aw: pw: l = 2.44: 2.50: 2.10. Width of clypeus to AME 0.13. Chelicerae: retromarginal teeth 4, closely spaced; distal tooth shorter than subdistal. Labium: L 1.26, W 1.54. Sternum: L 4.4, W 3.7. Legs: anterior leg ratios I = 4.7, II = 5.5.

Palps: Embolus coiled 8½ times.

Female ZMB 28.739 (holotype *Isopoda woodwardi* Simon)

CL 12.0, CW 11.5. AL 16.4, AW 13.7.

Colour in alcohol: cephalothorax and legs darker than holotype, abdomen without pattern; venter yellow-brown.

Eyes: AME 0.74. AME: ALE: PME: PLE = 1: 1.11: 0.54: 0.69. Interspaces: AME-AME 0.38, AME-ALE 0.53, PME-PME 1.43, PME-PLE 1.35, AME-PME 0.73, ALE-PLE 1.08. MOQ, aw: pw: l = 2.35: 2.54: 2.11. Width of clypeus to AME 0.14. Labium: L 2.00, W 2.50. Sternum: L 6.70, W 5.40. Legs: anterior leg ratios I = 3.8, II = 4.5.

Epigynum: (Fig. 25) Anterior broadly rounded; lateral rims somewhat parallel, barely diverging, not much broader posteriorly. Epigynal sclerite narrow, less than half length of fossa.

Variation

Carapace length of males, 9.58–11.86, mean 10.64 (n=9). Embolic coils 9 to 9¼ but one specimen has 8½ as in the holotype while another has 9¾. Carapace length of females, 10.24–13.67, mean 12.02 (n=21). Insemination duct coils 9. Abdomen dorsally may have a pattern consisting of 3 pairs of large brown-black patches.

Distribution and remarks

Occurs in arid and semi-arid areas of Australia from the west coast of Western Australia through South Australia and southern Northern Territory to south-western Queensland, western New South Wales and north-western Victoria (Fig. 35). Although a large spider, is often found in areas of low trees or mallee where it lives in hollows in the trunk as well as under bark. Hogg (1896) incorrectly identified two female specimens (in NMV) of this taxon from Alice Springs as *Voconia dolosa*. The three male specimens from the same locality have not been seen but are probably also *H. nigrigularis*.

Other material examined

Western Australia: ♀, Buningonia Spring, 31°24′25″S, 123°34′20″E, WAM 88/865; 3 juv., same locality, WAM 88/2052–4; juv., Burnabinmah Station, 28°47′S, 117°22′E, WAM 88/866; ♀, Goongarrie, 29°53′S, 121°10′E, WAM 88/880; ♀, Gullewa, 28°39′S, 116°19′E, WAM 88/1853; ♀, Kalgoorlie, 30°45′S, 121°28′E, NMV; ♀, Messengers Patch, 28°41′S, 116°57′E, WAM 88/896; ♂, Mt Margaret, 28°48′S, 122°11′E, WAM 86/663; ♀, Naretha 31°00′S, 124°50′E, WAM 88/1887; ♀, North Irwin River, 28°50′S, 115°42′E, WAM 88/910; ♂, Randells (Siding), 30°57′S, 122°15′E, BYM 56/A37; juv., Yundamindra, 29°18′S, 122°25′E, WAM 88/2127. **South Australia:** ♂, Bookabie, 31°51′S, 132°42′E, SAMA N1988496; penult. ♀, Cook, 29°49′S, 130°07′E, SAMA N1988480; 2 ♀♀, Durkin, 30°17′S, 133°44′E, SAMA N1988476–7; ♂, Fowlers Bay, 32°00′S, 132°27′E, SAMA N1988486; ♀, Gawler Ranges (without exact locality), SAMA N1988488; juv., Lake Acraman, 32°00′S, 135°32′E, SAMA N1988489; 2 ♀♀, penult. ♂, Lake Gilles, 32°38′S, 136°53′E, SAMA N1988490–2; ♀, Lincoln Gap, 32°36′S, 137°35′E, SAMA N1988495; ♀, ♂, Locks Well, 30°40′S, 136°03′E, SAMA N1988482–3; 2 ♂♂, Mabel Creek, 29°10′S, 134°10′E, SAMA N1988484–5; ♀, Mt Ives Station, 32°26′S, 136°04′E, SAMA N1988487; juv., Mt Willoughby, 27°58′S, 134°09′E, NMV; ♂, 'North' (no exact locality), SAMA N1988497; ♂, ♀, juv., Renmark, 34°10′S, 140°45′E, SAMA N1988498–500; juv., Stuarts Range, *ca* 29°00′S, 135°00′E, SAMA N1988481; 2 ♀♀, Yardea Station, 32°23′S, 135°31′E, SAMA N1988493–4; 2 juv., Vokes Hill (no exact locality), SAMA N1988478–9; 3 ♀♀, Wynbring Rocks, 30°33′S, 133°32′E, NMV. **Northern Territory:** ♀, Alice Springs, 23°42′S, 133°52′E, NTM A78; ♀, same locality, NMV; juv., Hermannsburg, 23°57′S, 132°46′E, SAMA N1988502; penult. ♂, MacDonnell Ranges, *ca* 23°40′S, 133°00′E, SAMA N1988501; ♂, Mt Gillen, 23°43′S, 133°48′E, NTM A95; ♀, Todd River (no exact locality), NTM A14. **Queensland:** ♂, Thargomindah, 28°01′S, 143°48′E, QM S12594. **New South Wales:** ♀, Nymagee, 32°04′S, 146°19′E, AM KS16632; 2 ♀♀, Springs Creek, 31°43′S, 142°41′E, SAMA N1988503–4. **Victoria:** ♂, Hattah, 34°41′S, 142°18′E, NMV; ♂, Meringur, 34°26′S, 141°26′E, NMV; juv., same locality but 34°24′S, 141°23′E, NMV; ♂, Millewa, 34°44′S, 141°04′E, NMV; ♂, Walpeup, 35°11′S, 142°11′E, NMV.

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ABORIGINAL – *ACACIA* RELATIONSHIPS IN CENTRAL AUSTRALIA

JOHN KEAN

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This paper collates existing information on Aboriginal perceptions and uses of *Acacia* species in Central Australia. Aspects of Aboriginal knowledge of the taxonomy, morphology and diversity of these species are presented, as part of a wider discussion of their economic, social and spiritual significance to Aboriginal people. The nature and extent of traditional Aboriginal–*Acacia* relationships demonstrate a sophisticated level of indigenous knowledge of *Acacia* and *Acacia* dominated ecosystems, that while being unique, is comparable to Western scientific systems.

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Trees and shrubs of a wide variety of *Acacia* species are dominant in most vegetation formations in Central Australia. The most notable among these is *Acacia aneura,* which gives its popular name 'mulga' to vast tracts of country throughout the region. Taken together *Acacia* shrubs form much of the living mantle over the Centre's ancient infertile soils and, as such, are critical to the ecology of the region. The characteristics and attributes of the genus were well known to Aborigines who used them in a diversity of ways to create secure and comfortable lives. The significance of the genus to Aborigines went beyond its economic and dietary contribution, for *Acacia* was predominant in the environment in which desert cultures developed. Accordingly, its importance is reflected in language, sociality and religious belief.

The first part of this paper establishes a broad overview of the genus *Acacia* and its distribution in the vegetation formations of Central Australia. The second section documents aspects of Aboriginal knowledge of the taxonomy, morphology, diversity and distribution of particular *Acacia* species. It also outlines some Aboriginal perceptions of the genus in relation to its environmental associations, ecology and management by fire. The final section examines the diversity of *Acacia* use by Aborigines with particular emphasis on the contribution of *Acacia* seeds to the diet of desert groups. The economy of seed processing is discussed and recent findings on the likely benefits to health from eating *Acacia* seeds are considered and cases of social and spiritual identification are cited to indicate the complexity of Aboriginal–*Acacia* relationships.

Study Area

The area regarded as Central Australia, for the purposes of this paper, lies between 125°30′ and 140° east and 20° and 29° south. This is the overlap between the areas defined as Central Australia by Jessop (1981) and by Hobson (1985). Both are depicted in Fig. 1, which has been based on a vegetation map prepared by Beard (1978 in Jessop 1981).

Orthography

Aboriginal statements and explanations will be used in the text. Where possible, the orthography used will conform with systems that have been developed for particular languages by the collaborative work of linguists, school teachers and community leaders. Orthographies and language names are drawn from the map 'Current Distribution of Central Australian Languages' (Hobson 1985) (Fig. 2).

The words *Anangu* and *Yapa* both mean 'people' in Western Desert and Warlpiri/Kukatja languages respectively.

Botanical Background

The Genus *Acacia* of the Family Mimosaceae

Species of the genus *Acacia* are indigenous to all continents except Europe and Antarctica. Simmons (cited in Doran 1983) estimates that there are 1,200 species worldwide. Australia has been the major centre of proliferation in the genus, with 729 species recognised and about 120 species yet to be described

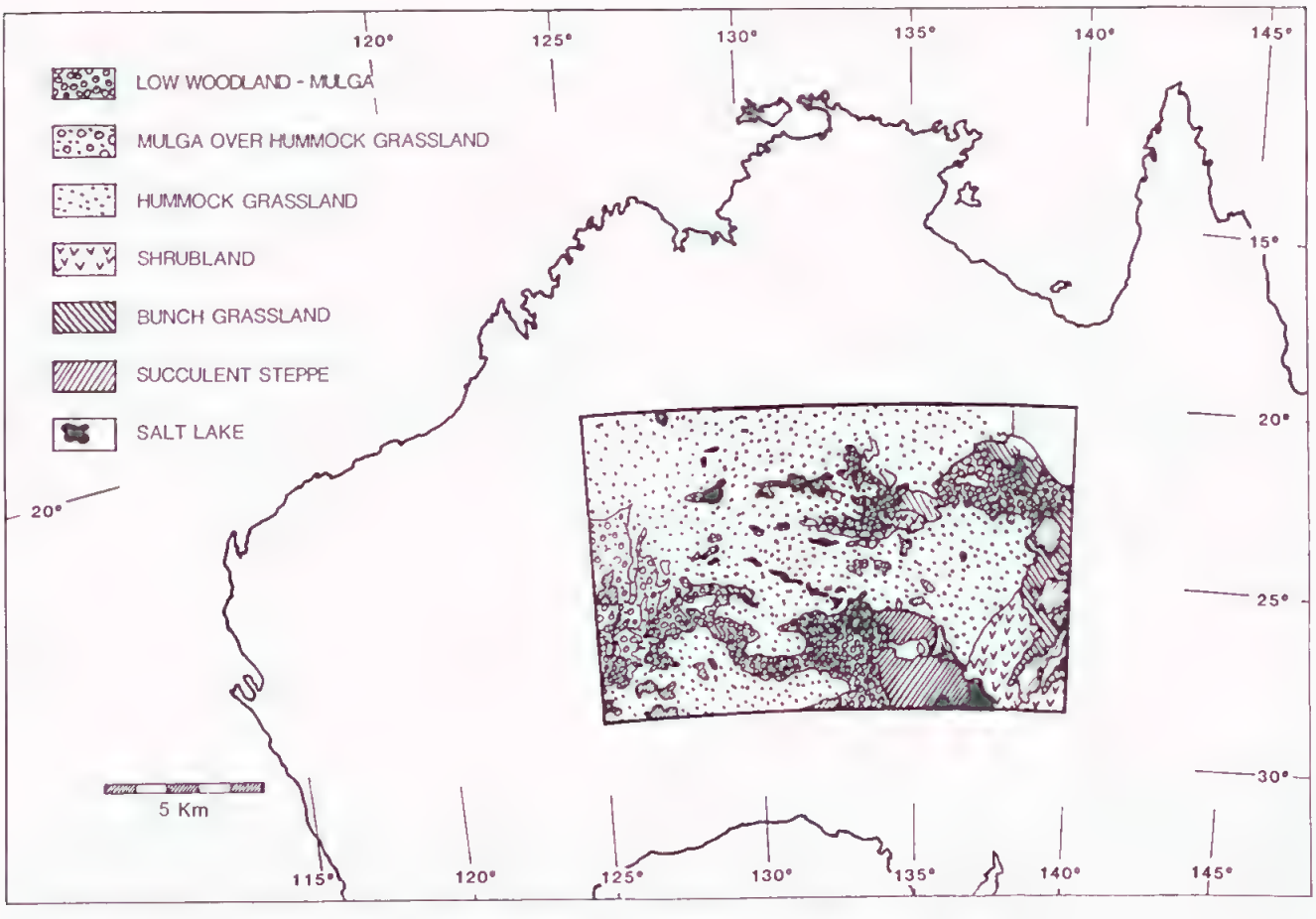

FIGURE 1. Vegetation of Central Australia (adapted from Beard 1978 in Jessop 1981).

(Maslin in Doran 1983). The majority of these species occurs in south-west Western Australia and 80% of those are endemic to that area (Hopper & Maslin, cited in Doran 1983).

In Australia, *Acacia* species are popularly called 'wattles' and are dominant in many of the savannah ecosystems, as they are in various regions around the world. 'The Flora of Central Australia' (Jessop 1981) describes 116 species of *Acacia* and although many of these are of economic importance to Aborigines, only a handful of these will be discussed in detail in this paper.

Most Australian *Acacia* are of the subgenus *Phyllodinae* which have their leaves modified to phyllodes and generally do not have either the thorns or bipinnate leaves characteristic of the genus in other parts of the world (Simmons 1981: 7).

The genus *Acacia* has several attributes and specific adaptations which has made it successful in Central Australia. *Acacia* species have been able to colonise the ancient infertile soils characteristic of the area through their capacity to fix nitrogen in specialised root nodules (Doran 1983). Latz (1982) describes many of the xeromorphic (desert) adaptations that have enabled *Acacia* to grow in conditions of low soil moisture. He puts particular emphasis on attributes such as enhanced germination and vegetative regeneration after fires that have recurrently swept the area.

Acacia in the Major Vegetation Formations of Central Australia

Beard (1981) defined the four major vegetation formations in Central Australia as bunch grassland, hummock grassland, low woodland and succulent steppe. To the north of the Tropic of Capricorn the two types of grasslands predominate. South of the Tropic, where significant rainfall can occur either in winter or summer, and grading to the extreme south where rain is as likely to occur at any time during the year, hummock grassland is contiguous with low woodland and succulent steppe. Beard also indicates that hummock grassland can occur in response to recurrent firing of areas that would normally carry low woodland.

In the north the bunch grasslands are confined to cracking clays. Hummock grasslands occupy other substrates including some calcareous soils. In the south hummock grassland (usually *Triodia* spp.) and low woodland (usually mulga, *A. aneura*) are found on the acid to neutral soils, while the

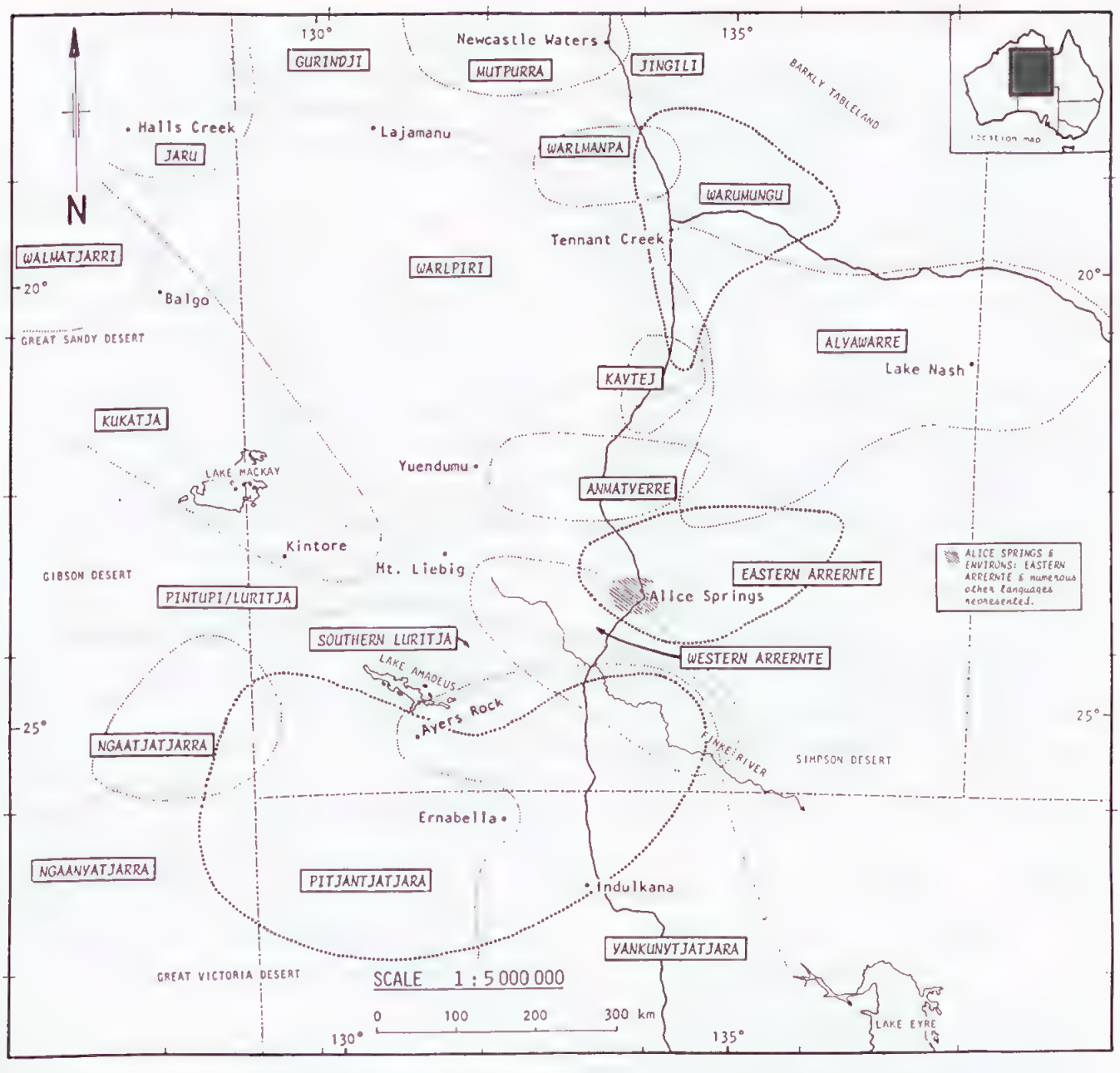

FIGURE 2. Current distribution of Central Australian languages (adapted from Hobson 1985).

succulent steppe occupies the alkaline and saline soils. Beard discusses this basic dualism. He notes the typical Australian sclerophyllous matrices, such as *Acacia* and *Triodia* communities, occur on poor leached siliceous soils. A different, more varied, floral array is associated with the base rich alkaline and saline soils.

The two most widespread formations are sclerophyllous in character. They are the hummock grassland and low woodland. Hummock grasslands, or 'spinifex' communities as they are better known, cover dunefields and sand plains throughout Central Australia. They are rarely treeless. *Acacia* species are prevalent and scattered throughout these communities. Most of the *Acacia* species mentioned in the text occur in these communities.

The low woodlands are usually dominated by *A. aneura* (mulga) and these communities are the second most extensive in the arid zone. Midgely & Gunn (1983) state that 1.5 million km^2 of Australia's arid and semi-arid zone are dominated by mulga communities, often forming dense monospecific stands. These mulga scrubs are in themselves extremely variable both morphologically and because of the composition of the understorey.

Latz (1982) describes two clearly discernible types of mulga scrub. 'Perennial mulga' has an understorey of perennial grasses such as *Eragrostis eriopoda* (woollybutt grass) while in 'annual mulga' an understorey of annual grasses and herbs predominates. Mulga can also harbour an occasional eucalypt or contain other *Acacia* species

such as *A. cambagei* or *A. pruinocarpa* (Beard 1981). Mulga can also occur in scattered stands in many of the other plant communities of the arid zone. It is only in the salt lakes and Mitchell grass communities that it is totally absent (Latz 1982).

The succulent steppe formation is divided into a number of distinct communities. In the south of the study area calcareous soils are often dominated by *Maireana* sp. (bluebush) and a number of *Acacia* have adapted to these alkaline conditions, becoming dominant trees in some areas. *A. calcicola* is significant in the south of the area, while *A. georginae* is common in the east (Latz 1982).

The calcareous but slightly saline soils are dominated by *Atriplex* (saltbush) communities and *Acacia* species are less common. The highly saline areas are vegetated principally by *Halosarcia* sp. (samphire) and *Acacia* are absent.

There are many smaller environmental associations whose size may belie their ecological significance. *Acacia* shrublands often merge with low woodland, forming composite mosaics or (as it happens in the south-east of the study area) they may stand as distinct entities. There *A. ligulata* and *A. tetragonophylla* form sparse shrublands (Beard 1981). Similarly distinct are some *A. kempeana* (witchetty bush) shrublands which can inhabit the alluvial soils associated with limestone or dolomite outcrops around the central ranges (Latz 1982).

Aboriginal Classification and Description Of *Acacia*

Taxonomy

It is unlikely that there is a single system of plant classification that will be shared by all Central Australian language groups. Even within these groups there are inconsistencies. Each clan may possess a distinctive linguistic and classificatory knowledge (pers. obs., Walungurru, 1984–5). However, the following discussion of Aboriginal plant taxonomy reveals trends that can be compared with popular European and western scientific systems.

In Warlpiri, flora classification distinctions are made on the basis of the following properties: woodiness, habitat, growth habit, relative size and usefulness, including edibility. For example, an initial assessment is made according to whether a plant is woody or not. Woody plants, such as *Acacia,* are *watiya,* and non-woody plants, such as grasses, are *marna.* If a plant produces edible parts it is *miyi.* If those parts are seed, as is often the case with *Acacia,* then it is *ngurlu.* If the edible substance provided by a plant is insect gall or lerp or larvae it is *parnta.* This category also refers to nectar and honey, which are not utilised from *Acacia.*

From my research into Central Australian nomenclature there is no generic term for legumes or for *Acacia.* Most names for *Acacia* are species specific. Conversely, Aborigines differentiate between varieties and subspecies that have not as yet been recognised by western taxonomists. Piele (1980: 62) refers to the case of *A. ptychophylla* which Gugadja [Kakatja] speakers recognise as two distinct entities, *nyirrtjatu* and *tjamunpa.* European taxonomists do nonetheless accept that mulga *(A. aneura)* is a variable species or species complex.

Because of the widespread dominance and economic importance of mulga *(A. aneura)* it is not surprising that there has been a proliferation of terms to describe it in indigenous languages. Goddard & Kalotas (1988) found that the Yankunytjatjara differentiate between five varieties of mulga (see Table 1). Despite this recognition of differences the Yankunytjatjara also acknowledge generic uniformity by using the term *Kurku* for all five varieties.

Knowledge of Species Diversity

Table 1 demonstrates that the absence of a written system for recording plant names did not inhibit the development of sophisticated skills of linguistic recognition and differentiation in Aboriginal

TABLE 1. Five *Acacia aneura* varieties as recognised by Yankunytjatjara speakers (adapted from Goddard & Kalotas 1988).

Name of Variety	*Leaf Characteristic*	*Most Notable Use*
Kalpilya	Long, narrow, flat	For making boomerangs [Kali]
Minyura (desert mulga)	Shrubby, blue	Resin for implement manufacture and repair
Puyukara	Long, narrow, flat	—
Tjamalya	Long, narrow, flat	Seeds not used as food
Wintalyka	Common variable leaf form	Seed important food source

culture. But not everybody in the community had the same level of botanical knowledge (Piele 1980). The acquisition and retention of such information would be affected by many factors — regions traversed, sex, age and even individual spiritual associations with particular areas of land and associated totems. Accordingly, knowledge can be viewed as either an individual or a community/cultural attribute.

Latz (1982), in the most systematic study of ethnobotany of Central Australia, lists 32 *Acacia* species as being used for food alone. Nash (n.d.) lists 37 *Acacia* as being recognised by Warlpiri, Warlmanpa, Warumungu and Alyawarre speakers living in areas to the north of Alice Springs. Twenty-six *Acacia* species are described by the Warlpiri Lexicography Group (1986) and 24 *Acacia* species are listed by O'Connell *et al.* (1983) in their work with Alyawarre speakers.

Plant Related Terminology

As well as an extensive knowledge of floral diversity, speakers of Central Australian languages can call on a sufficiently specific vocabulary to allow detailed descriptions of plants and their parts. In Western Desert languages the same terms are often used to describe plant parts as those for human/animal anatomy. Table 2 sets out some Yankunytjatjara terms that are relevant to the description of *Acacia*.

Acacia Distribution and Soil Associations

Transcriptions of Yapa statements indicate that they identify the presence of *Acacia* and other plant species with particular environmental units and soil types. In a long explanation of the distribution,

TABLE 2. Yankunytajatjara terms relevant to the description of *Acacia*. (From Goddard & Kalotas n.d.).

Yankunytajatjara Term	*English Meaning*	*Literal Translation*
Unturuntu	Flower	
Pilyuru	Pod (mainly of *Acacia* and *Cassia*)	
Kalka	Seed	
Yuti	Seed appendage e.g. coloured aril on some *Acacia*	Iris of eye
Kalpi	Broad leaf	Feather
Parka	Narrow leaf	
[?] Tjanikiri	Small leaf	
Miina	Branch, stem	Arm
Anangu	Tree trunk, main stem	Body
Tjarapa Kutjara	Tree fork	
Wata	Base of trunk	
Muti	Log, stump	Knee
Likara	Bark	
Aturu	Lateral root	
Tjiilpa	Tap root	
Tjilka	Prickle, thorn	
Taltja	Knot in timber	
Murtjul	Insect gall	Knot, tangle
Unytjunytju	Fallen leaves, leaf litter	
Piltirrpa	A dried tree	
Wiirwirpa	A bare tree	

growth and use of *Kanarlarrampi (A. cowleana)* the following observations were made:

> Kirrirdi-kirrirdi yika karri kanarlarrampiji. Wantiki. Kulaka karruwanarlangu karri, karrungkaju kujaka karri kanarlarrampipiyayljala nyanungupiyayijala ngulaju jintapardukarija. Kala nyampuju — manangkarrangawurrpa, manjangawurrpa kanarlarrampiji.
>
> The *kanarlarrampi* is rather tall and wide. It does not grow along creeks in white sandy soil. The tree which does grow along sandy creeks and which is like the *kanarlarrampi* is a different one. Whereas the *kanarlarrampi* belongs to the spinifex country and to the mulga scrub. (Warlpiri Lexicography Group 1986: 10).

While knowledge of the presence of a plant in a particular habitat can be linked to the potential for its exploitation, the following account of the exclusion of mulga from a specific soil type points to an understanding of soil as a limiting factor to the growth of particular plants:

> Manja kalu pardimi walya yangka patinyayirnirla kujaka larra-larra-parnka. Tarnnga kalu karrimi yulyurrpurla manu wantangka. Kulaka yatujumparra pardimi manjaju walya maru-marurlaju.
>
> The mulga tree grows in very hard firm soil which cracks. They grow all the year round – in winter and summer. The mulga doesn't grow in the north which is black soil country. (Warlpiri Lexicography Group 1986: 21).

Kimber (pers. comm.) has also observed that Aboriginal people distinguish differences in the 'flavour' of some fruits, particularly *Kampurarrpa* (bush raisin), when they grow on different soil types. He notes that both men and women possess a knowledge of preferred localities for obtaining sweet fruits.

Much of the ethnobotanical research conducted so far has been concerned with the compilation of species lists, details of plant use, methods of preparation and ritual associations. The Aboriginal concepts of soil/plant relationships have been largely ignored in the published literature of Central Australia.

Acacia–Animal Relationships

Aboriginal knowledge of the bush and its animal resources, though popularly accepted, has often been mystified. Aboriginal explanations of *Acacia*–animal interactions indicate how specific knowledge of habitat and feeding relationships was used to efficiently exploit local environments.

Animals are often linked with their habitats and it is not surprising that the red kangaroo *(Marcropus rufus)* is called *ngarrirni manjangarna* or 'mulga dweller' by the Warlpiri who associate it with mulga woodlands. Skills of observation and a detailed knowledge of feeding relationships are revealed in the following statement by Mollie Everard who explains how the presence of birds can act as an indicator for the availability of edible 'honey dew', which forms on the upper branches of mulga trees when sap sucking scale insects are present (Latz 1982):

> 1. Nyakukatipai. Ka 'Tjulpu nyara nyawa! Tjulpu nyara ilura waninyi.'
> 2. Pika ngurpatja nyakukatipai, pirpipirpira wanani.
>
> 1. You spy it as you're on the move. 'Look at the birds over there! They're all over the place.'
> 2. You see — oh, just too much honeydew for words, glittering along the branchlets. (Everard, cited in Goddard & Kalotas 1988: 41).

The red lac scale if not collected by Anangu may be used by honey ants *(Camponotus inflatus)* which are also associated with mulga woodland. Edimintja (pers. comm., Ilpili Road, 1978) explained how ants collected the *turatja* (honey dew) from mulga trees and carried it via a tiny hole in the ground to feed other ants with swollen abdomens in caverns a metre under the surface. From there the honey ants could be extracted by humans, after a considerable effort (see also Cleland & Tindale 1959: 134).

Witchetty Grubs *(Xyleutes biarpiti)* are specifically associated with *A. kempeana* and in the recent past formed a crucial part of the diet of many desert groups. Tindale (1953, 1981) stressed the importance of this and other species of cossid larvae in the nutrition of desert people and in particular during the weaning of children.

After a visit to the Mt Liebig area in 1932 Cleland and Johnston reported that witchetty grubs

> . . . are much sought after by rabbit-bandicoots, *Thalacomys lagotis* [now *Macrotis lagotis*]. These scratch the soil away from the roots, but they may be disturbed or may find the root containing the insects too difficult for their extraction. The natives, in searching for these grubs, look for places where marsupials have been burrowing. If they find the root has been gnawed through they proceed no further; but if the root is still intact, then they wrench it out and frequently find the insect (Cleland & Johnston 1933: 120).

The *Ninu (Macrotis lagotis)* is now an endangered species throughout its range. The opportunities for Anangu to exploit the witchetty grubs excavated by the *Ninu* have largely disappeared with the animals. On a field trip in June 1988, the author together with Dr Christopher Anderson of the South Australian Museum were travelling with three Pintupi men in the area to north of the Walangurru Community when similar

observations were made to those of Cleland & Johnston (1932). As the car passed through sandhill country there was suddenly an area of several hectares dominated by *A. kempeana*. Conversation turned to the animals. We stopped the car and within a minute Willie Tjungurrayi, who had grown up traditionally in the desert, located a witchetty root that had been excavated by *Ninu*. The root was levered out and the grub extracted.

Acacia and Land Management by Fire

The most important land management tool available to Aborigines was fire (Hallam 1975; Jones 1969; Kimber 1983; Latz & Griffin 1978). Latz (1982) indicates that the vegetation of Central Australia was so adapted to the traditional Aboriginal fire regime that in many ways it was better able to survive fire than drought. According to Latz & Griffin (1978) a great number of food producing plants respond positively to the incidence of fire: 50% of the plants they judge as being most important to the pre-contact economy increased in numbers after burning while only 10% showed a long term reduction. However, fire was not used indiscriminately and the relative tolerance of various species to burning was taken into acount as specific stands of vegetation were burnt for anticipated results. Latz (1982) described an idealised result of a typical Central Australian fire regime:

> Maximum *Acacia* seed production will be available from a given area when burning is carried out in such a way as to produce a mosaic of plant communities in different stages of fire recovery. This includes some areas which have been protected from hot summer fires for considerable periods or have only been subjected to cooler winter fires (Latz 1982: 58).

Latz defines three typical responses of *Acacia* species to fire and in so doing indicates the potential for their management as a food resource:

i) species that are not much affected and quickly recover, often producing seed six months after a fire event (e.g. *A. coriacea)*;
ii) species in which individuals are killed but seed germination is enhanced, with seed production commencing 2–4 years after fire (e.g. *A. dictyophleba)*;
iii) species killed by fire with significant seed production commencing only after 5–10 years (e.g. *A. aneura)*.

It seems that Aboriginal people were also aware of the effect fire had on specific plants and plant associations, and that they took these factors into account in their use of fire. Kimber (1983) concludes that there was an understanding of the susceptibility of mulga *(A. aneura)* to fire and a general avoidance of burning wooded areas. Conversely he indicates that spinifex and other grasslands were burnt routinely in both small patches and on a broad scale.

European settlement generally suppressed traditional Aboriginal burning practices. However, the introduction of land rights, increasing Aboriginal ownership of vehicles, and the growth of the outstation movement have been among the factors that have led to the resumption of widespread burning, particularly by Pintupi, Luritja and Warlpiri people (Cane & Stanley 1985) (see Fig. 3).

Acacia: Aspects of use and Social Identification with the Genus

Acacia: The Diversity of its Use

Acacia plants composed much of the living mantle of the arid zone. Mulga woodland enveloped its human inhabitants, giving them shelter and

FIGURE 3. Fire patterns in the Pintupi homelands, 1981, 1983 (Cane & Stanley 1985).

warmth from firewood that could burn right through a freezing night. The same trees provided a habitat for important food animals and timber for weapons to hunt them. The seed production from various *Acacia* species would have made it possible for large groups of people to gather for ceremonies and be assured of an abundant supply of nutritious food (Latz 1982). A variety of *Acacia* trees and shrubs provided many of the medicines that were used to maintain health and well-being. *Acacia* was thus deeply interwoven with the economic, social and spiritual lives of Central Australian people.

Acacia Seeds as Food

The Grinding Process

Smith (1986), in a comprehensive survey of the archaeological evidence for seed grinding technology, has demonstrated its vital role in shaping occupation and patterns of land use in Central Australia. In balancing the forces of population density and carrying capacity, seed grinding may have variously facilitated higher population densities, extended the range of foods available to people, and intensified the use of resources. This technology remained an integral part of desert culture until the advent of wheat flour with the coming of Europeans. Murika, a Yankunytjatjara woman, explains the process of dry milling mulga seeds:

1. Punu putungka tjunkupai. Punungka tjunanyi munu wantinyi.
2. Munu nyinara yankula nyanganyi. Piltiringanyi.
3. Ka 'Ai! Ngayuku mai piltiringu!' Panya palunya yalkanilta.
4. Yalkara ka purputukatinyi.
5. Ka nyulkara palunya pungku-pungkula kalkani, munu palunya wirangka tjunanyi.
6. Munu paluru kanini, kanini palunya. Wirangka kanini, wintalyka palunya.
7. Kanini, munu tjaruwaninyi, mimpungka tjaruwaninyi.
8. Munu palunya tjalira kulpanyilta.
9. Munu ngurangka paluru katira tjunkula, ipangka pauni, mai palunya, ka paluru pilta-piltatjunanyi.
10. Ka paluru paura, ararangkula, kaninilta. Kanira kalkani, mai palunya.
11. Tjiwa urani, munu palunya rungkani, rungkara anytjuni.
12. Munu nyaangka, tapaltjura palunya mai rungkani, mai palunya. Ka paluru tapalta pulaparingu.
13. Ka ngura tjitji tjutangku nganana ngalkupai. Nganana talturingkupai.
14. Mai paluru pulka, tjamuku, kamiku, mai kunpu. Nganana mai palula pulkaringu, palawa wiyangka.

1. You put some mulga branches on an old flat termite nest and leave them there.
2. Then after a while, after travelling around a bit, come back and check it. It dries out.
3. 'Ah! This food of mine has dried out nicely!' Then you thresh it.
4. As you thresh it, the pods fall out all over the place.
5. By rubbing them and tapping them you get the seed out, and put it in a dish.
6. Then you yandy [winnow] the mulga seed in the dish.
7. Once it's yandied, you tip the clean seed into *mimpu* bowls.
8. Then load up on your head and return to camp.
9. Having brought it to camp, you parch the seeds in hot ashes, and the hard seed cases crack open.
10. After roasting it, you winnow and yandy it again, to separate the seed inside.
11. Then you get a grindstone, and grind it up, wetting it as you grind.
12. You put a collecting vessel beneath the lower grindstone and it builds in that.
13. We used to eat it as kids. We'd get full.
14. It's an important food: a food of our grandfathers and grandmothers, a strong food. We grew up on this food, without flour. (Murika, cited in Goddard & Kalotas 1988: 39–40).

Murika provides a general description of the process, but seeds may be used in several ways depending on the species. For instance, larger seeds are pounded after parching and before grinding. Other reports indicate that seeds were sprinkled with water during grinding and the resulting paste was baked as damper (O'Connell, Latz & Barnett 1983). Seeds of some species, such as *A. coriacea*, are collected green from the bushes and roasted briefly on a small fire or burning clumps of spinifex. In this form they have a delicious nutty flavour.

Seed Processing — Efficiency and Energy Return

While 'bush tucker' is still avidly collected and usually preferred to 'canteen' food by people on the 100 or so outstations scattered throughout the Central and Western Deserts, the abundant seed resource is now largely neglected (Cane & Stanley 1985). Ready availability of processed white flour as a direct substitute for 'bush' flour has prompted the decline in the use of a wide variety of seed yielding species (O'Connell, Latz & Barnett 1983). This is not surprising as although native seeds are more nutritious and flavoursome than wheat flour, they are also very time consuming to collect and process.

O'Connell, working with Alyawarre women in 1974, recorded the data (presented in Table 3) for the energy return per unit time taken to collect and process seed from three *Acacia* species. Values for other desert staples are also included for comparison.

These data confirm that traditional methods of collecting and processing *Acacia* seed are inefficient, especially when compared with energy returns per

TABLE 3. Collecting and processing times and energy returns for bush foods (including seed of three species of *Acacia*). *(Adapted from O'Connell, Latz & Barnett 1983).*

Species	*Collecting and processing time (h/Kg)*	*Energy Value (K cal/Kg)*	*Energy return per unit time spent collecting and processing (K cal/h)*
A. aneura	6.50	3778	580
A. coriacea ripe	5.25	3551	676
unripe	0.60	2600	4333
A. coweleana	6.59	3589	552
Ipomoea costata	0.25	1563	6252
Solanum centrale	0.50	2992	5984
Cossidae grubs	1.75	2600	1486

unit time for other favoured and now more frequently collected bush foods, such as cossid grubs (from *A. kempeana* and a variety of other plant species), *Ipomoea costata* (wild potato) and *Solanum centrale* (bush raisin).

Acacia coriacea can be relatively efficiently collected for it grows as a low tree with 8–12 seeds in each pod, but when milled for use as damper, the energy return is only slightly greater than that for *A. aneura*, which has smaller seeds with only about three seeds per pod. From these data it would appear that the grinding stage of seed processing is the most time consuming as well as the most arduous for the Aboriginal women who have traditionally carried out this task.

When the grinding stage is omitted and the lightly roasted seeds are eaten at an unripe stage the energy return is increased sixfold. In this form the energy return for *A. coriacea* is comparable with values for the other frequently collected staples (see Table 3). Consequently this species is still utilised when the unripe seeds are available during October and November (pers. obs., Walangurru, 1984).

Contemporary Implications for the Use of Acacia *Seed as Food*

The urge to escape the drudgery of traditional food-gathering life and particularly the incessant seed grinding that was an integral part of it, must have been a key incentive for the people of the Western Desert to abandon their economic independence. During most of this century 'sweet tucker' in the form of processed flour, sugar and tea has been provided to Aborigines by the missions and later government settlements fringing the Western Desert.

Pupulu Tjupurrula describes how (when he was a boy) white flour was used by Lutheran missionaries to lure his family from the Walangurru/Mitukatjirri area to a state of economic dependence in the mission station at Haast's Bluff:

> They [the missionaries] bin makin big home in Ilpili aerodrome, they're sitting down. Alright, that's the time we tasted tea and flour. Really sweet! Sweet this tucker, we'll follow this one east. We bin travelling this way now. Tjina [on foot] we bin travelling. Right, we saw Putati [spring site/ration depot]. Oh! mayi too much here — flour. Oh [the missionaries] got'im proper big box that they put on the camel. That time our mob was eating flour. (Kean 1984).

The last ten to fifteen years have seen the resurgence of an Aboriginal determination for political and cultural independence. A key manifestation of this movement has been the creation of many small outstations throughout the Western and Central Deserts. There are now more than 2,400 people living on outstations in Central Australia (see Cane & Stanley 1985). Although these communities are largely financially dependent on government subsidies, bush resources in the form of food, building materials and materials for artefacts for sale are also significant in the outstation economy. Cane & Stanley (1985) have estimated that in the 53 outstation communities they surveyed, the equivalent of one meal in four came from the bush. In financial terms, they calculated a contribution of $616 per person per year from bush tucker when the average yearly income was only $2,500 per person. Given the development of an appropriate milling technology, *Acacia* seed could again be widely used to further

enhance economic independence of outstation communities.

Warlpiri and Western Desert women have proved by their involvement with the seed industry that there is still an enthusiasm for the collection and processing of *Acacia* seed. When *Acacia* seed has been in demand by the organisers of local and overseas re-afforestation programmes, the amount of seed collected by the women has invariably outstripped the market (Baarda 1983; Horner pers. comm.). Given the demonstrated urge for independence and the fact that many outstations are already established on resource rich areas, it is likely that an efficient milling technology would be accepted by such communities.

A suitable mill should be robust and virtually maintenance free to be practical on outstations where there are few if any substantial buildings. The availability of appropriate milling technology could mean the resumption of use of this important traditional food source where highly developed skills for seed collecting and winnowing could be incorporated without suffering the back-breaking grinding stage of the process.

As tastes have undoubtedly changed since contact with European foods, a mixture of *Acacia* and wheat flour may now be most palatable to Aboriginal people. Cherikoff (pers. comm.) suggests that a mixture with 70 per cent *Acacia* produces a good textured damper. It would be Aboriginal experimentation, however, that finally determined how and to what extent ground *Acacia* meal was used. Resumption of use of the *Acacia* seed resource could lead to improvements in the economic and political independence of remote Aboriginal communities.

Nutrition and Health

Analyses by Brand & Cherikoff (1985a, 1985b) demonstrate that *Acacia* seeds have higher energy, protein and fat contents than crops such as wheat and rice. Their results, together with those of other workers, for the composition of nine *Acacia* seeds and one gum exudate are presented in Table 4.

TABLE 4. The composition of *Acacia* products per 100g edible portion (adapted from Brand & Cherikoff 1985b).

Foods	*Description*	*Energy*	*Water*	*Protein*	*Fat*	*Carbohydrate*	*Fibre*	*Ash*	*Na*	*K*	*Mg*	*Ca*	*Fe*	*Zn*	*Cu*	*Vitamin C*
		kJ	*g*	*g*	*g*	*g*	*g*	*g*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*	*mg*
Acacia aneura and *Acacia kempeana* mulga and witchetty bush	seeds	2220	4.3	23.3	37.0	25.5	—	9.7	37	805	—	113	—	—	—	—
Acacia coriacea dog wood	green seed	627	56.8	23.7	3.3	6.4	8.2	1.6	3	362	75	137	3.2	1.0	0.4	—
	dry seed	1240	4.1	20.9	9.3	33.8	28.2	3.7	4	784	170	318	7.7	5.8	1.0	—
	dry seed	1491	17.0	23.8	7.7	48.1	—	3.7	61	357	—	84	—	—	—	—
Acacia cowleana	seed	1507	15.6	22.2	10.1	44.6	—	7.2	96	290	—	114	—	—	—	—
	seed	—	5.5	23.4	9.8	36.4	—	—	—	—	—	—	—	—	—	—
Acacia dictyophleba	seed	1519	11.2	26.8	6.3	49.0	—	6.5	84	221	—	88	—	—	—	—
Acacia estrophiolata ironwood	gum	1429	7.1	0.2	0	89.1	0	3.6	6	721	37	587	0.9	2.6	0.4	—
Acacia kempeana	seed	1631	5.6	22.9	10.2	51.0	—	10.1	112	392	—	72	—	—	—	—
Acacia murrayana Murray's wattle	seed	1107	5.4	18.1	5.8	37.6	28.9	4.2	4	800	218	213	6.6	3.7	0.7	—
Acacia pachycharpa	seed	1598	7.1	22.2	8.3	57.1	—	5.3	—	—	—	—	—	—	—	—
Acacia tenuissima	seed	1469	1.6	25.0	15.6	29.2	25.7	2.9	5	678	118	144	6.8	3.2	1.4	—
	seed	1592	14.5	24.8	16.4	33.0	—	11.1	89	372	—	80	—	—	—	—
Acacia victoriae bramble wattle	seed	1082	4.9	17.0	3.8	40.8	29.4	4.1	8	756	136	383	10.6	1.7	0.6	—

In some *Acacia* species, such as *A. coriacea* and *A. tenuissima,* most of the oil is in the aril (seed attachment). The aril is easy to detach and was traditionally mashed and used as a drink (Brand & Cherikoff 1985a). The bare seed remains may then have an oil content of less than five per cent (Cherikoff pers. comm.).

Cherikoff (pers. comm.) suggests that the traditional practice of parching the seed before milling served two functions — the first being that they were easier to grind once the hard seed coat became brittle and, secondly, that small quantities of enzyme inhibitors are destroyed, resulting in a food of high nutritional value.

Cherikoff (pers. comm.) also suggests that one potentially significant advantage of using *Acacia* seed as food is its demonstrated protective role against Type 2 (non-insulin dependent) diabetes mellitus. This is a disease of major proportions among the now sedentary, white flour and sugar dependent indigenous people of Australia. Mobbs (pers. comm.), while acknowledging the extent of diabetes among Aborigines in the Centre, warns against regarding the eating of *Acacia* as a panacea for a disease which she views as also largely lifestyle related.

It is interesting to note that the Kukatja were aware of the medicinal qualities of *Acacia* seeds over and above their value as food. The following description is of *Mulunturu (A. coriacea)*:

> Mulunturu. Yalpa . . . good medicine . . . Kalyu - kurlu - lu. mix - em - up tjikila - latju wiyala. Mimi kaniny - tjarra - lu palya rringu tjikirinu - ka palya - rringu, tjurni ngawu - lu might be tjarlu - tjarlu tjikirnu palya - rringu
>
> *Acacia* seed is good medicine. Mix it with water. Drink it and it will make an end (of sores and sickness). When you are sick internally. Say bad stomach. Perhaps you might have diarrhoea. Drink it and you will become better. (Piele n.d.).

Social and Linguistic Identification with *Acacia*

The search for an appropriate idiom is, in my experience, as enthusiastically pursued by some Pintupi and Luritja speakers as it is by the most imaginative English speakers. The Warlpiri language also offers colourful expressions. One *Acacia*-related analogy *Jurru-marntarla*, is used of a person who is hard-headed, stubborn, obstinate and insensitive; literally it means 'head — *A. pruinocarpa*', a tree which is noted for the hardness of its wood (Warlpiri Lexicography Group 1986: 25).

On a broader level Warlpiri recognise the major vegetation division that runs east-west across their country (at about 22° south) and incorporate it into expressions of their identity:

> Manjawardingki karnalu kurlirra nyampurla nyinami. Panukari kalu nyinami yatijarra manangkarrarla. Warlpiriyijala.
>
> We are the people of the mulga country who live in the south here. Others live to the north in the spinifex country. They are Warlpiri also. (Warlpiri lexicography Group 1986: 21).

Spiritual and Ritual Links with *Acacia*

Many of the Anangu/Yapa descriptions cited in the previous pages have their origin in Tjukurrpa ('Law' or Dreaming). For the Warlpiri and Western Desert groups, Tjukurrpa encompasses both events of a distant 'Creative Era' and the precedents that were established by the ancestral heroes which have been passed down to the contemporary custodians of traditional Aboriginal Law. The activities of *Acacia* ancestors are among the host of human, animal, plant, celestial and atmospheric constituents of the pre-European world commemorated at sites throughout Central Australia. Individual custodians are spiritually and ritually linked to these sites and the particular ancestors associated with them.

In the following account by Hercus & Clark (1986: 57) of the *Acacia* ritual centre Pudlowinna in the Simpson Desert, a recurrent link between ancestral grindstones and sites associated with edible seed bearing *Acacia* species is established:

> There is a song cycle usually referred to as 'the Grinding Stone from Pulawani' by Mick McLean who was the last person who could chant the verses. The Grinding Stone referred to is a *ngampa*, that is not a flat grinding dish but a thick lower mill-stone on which the seeds of small trees were pounded. The trees were *Acacia ligulata*, the sandhill wattle, *Acacia dictyophleba,* and *Cassia nemophila*. This song-cycle is a most moving piece of literature. It begins with a description of drought, and dry leaves falling from the trees. The next few verses are whispered with sharp intensity — let the dry roots and stumps become green, bright green. Then comes a description of shoots gradually appearing and roots spreading out. Then a *kultji* a small round stone is put under the tree to make it fruit with profusion. The seeds form, they ripen and are ground and the dough is cooked. In the meantime the ancestral *ngampa* stone disappears, but the Pudlowinna people paint up for a ceremony. An Ancestor (unnamed) finds the stone — it now has a handle like an axe. He takes it back to the well and it grinds the seed continually. The song ends with the ceremonial verses.

A bilingual version of 'The seed song from Pulawani' by Mick McLean has now been published (see Hercus 1990). In her introduction to the translation Hercus notes that it '. . . was the main song used for the increase in *ngarralja*, that is hard seed, such as *Acacia* and pigface seed' (1990: 117).

Widespread association of grindstones with particular *Acacia* plants is further emphasised by a 1978 painting by Toby Brown Tjampitjinpa. In this painting (see Fig. 4) Tjampitjinpa depicts the travels of an anthropomorphic grindstone/woman through Anmatyarre country. Tjampitjinpa said that when the grindstone/woman stopped, mulga trees grew out of her. He explained, that the grindstone/woman was a mother and the trees were children from which mulga seeds could be collected for food. In his painting the two largest sets of concentric circles represent the 'mother' at her camps, while the smaller sets of circles emanating from her represent her children, the mulga trees of the area.

FIGURE 4. Mulga trees growing out of a grindstone/woman in Anmatyarre country. By Toby Brown Tjampitjinpa (Papunya Tula Artists).

Clifford Possum Tjapaltjarri, a countryman of Tjampitjinpa, has also depicted many of the 'mulga seed' ritual centres of the dense mulga woodland of the western Anmatyarre area. In the late 1970s Tjapaltjarri completed a series of paintings which mapped the intersecting paths of many Dreaming trails over large areas of Anmatyarre country. In one of these paintings several sites associated with mulga seeds were illustrated as surrounded by the symbols of other significant sites and stories. That is, the sites are represented as an integral component of a 'Totemic Landscape' (Strehlow 1970).

Tjanypapakanu is an increase centre for mulga seed and in Tjapaltjarri's painting (Fig. 5) the site is represented by the grey concentric circles from which lines of grey dots appear to be exploding. This is the site from which mulga trees in this area are believed to be spread. Established mulga groves are represented as clusters of grey dots scattered throughout the painting; the small black overdotting represents the mulga seeds themselves.

At Rrunyalyitja, to the east of Tjanypapakanu (see Fig. 6) a seated woman is depicted grinding mulga seed; her top stone is represented as the adjacent oval. Tjapaltjarri indicated that this stone still survives as a smooth white rock at Tjanypapakanu (pers. comm. 1978, 1984). The sections reproduced in Figs 5 and 6 represent approximately one quarter of the total area of the painting.

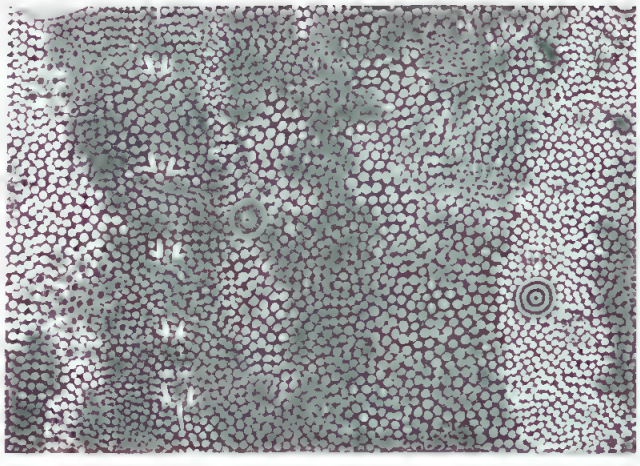

FIGURE 5. A mulga seed increase centre at Tjanypapakanu. Details of a painting by Clifford Possum Tjapaltjarri (collection of the author).

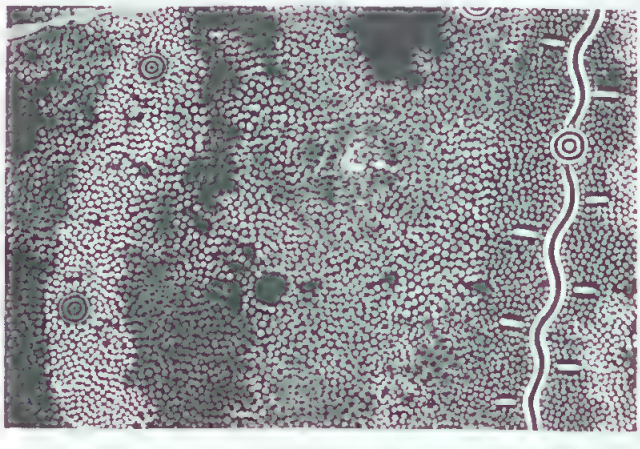

FIGURE 6. A woman grinding mulga seed at Rrunyalyitja, a site to the east of Tjanypapakanu (above). Detail of a painting by Clifford Possum Tjapaltjarri (collection of the author).

Nash (1984) describes traces left in the landscape by the grinding of *A. tenuissima* by an old woman of the Tjukurrpa. The following account illustrates how distant events are recreated in ceremony by the contemporary custodians of this story:

> The northern series of hills adjacent to Mt Liebig are believed to have been formed by an old woman who sat at the top of the mountain and ground seeds of *Acacia tenuissima* incessantly, creating huge piles of seeds, the hills. The woman's songs and actions for this dreaming contain many references to watiyawana. They simulate many aspects of gathering and processing such as 'winnowing' of sand on dancing boards to represent the watiyawana seeds being winnowed in wooden dishes. The dancing boards themselves are painted with watiyawana designs depicting important places and events in the sequence of Dreaming events. Yellow dots are painted to represent the yellow *Acacia* blossoms. (Nash 1984: 34).

A 1986 painting by Sandra Nampitjinpa of the Watiyawana story (see Fig. 7) depicts the same ceremony as described by Nash. In this small painting the women are represented as the crescent shapes, while the adjacent shapes are the dancing boards in the performers' hands. Fighting sticks topped with cockatoo feathers and decorated with watiyawana imagery are evoked standing erect at focal points in the ceremonial ground. This painting is in the collection of the South Australian Museum (A65163).

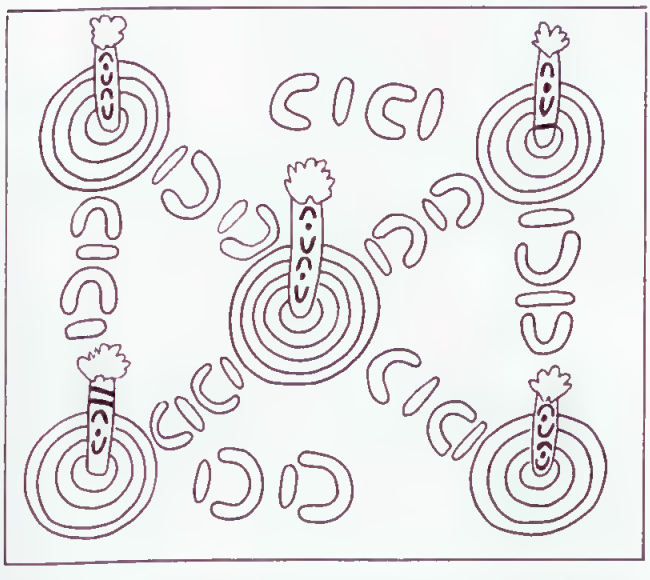

FIGURE 7. Watiyawana by Sandra Nampitjinpa (adapted from South Australian Museum A65163).

While each of the *Acacia*-related Tjukurrpa documented here are unique and of significance to particular Aboriginal groups, they are at the same time representative of general trends in the belief systems of Central Australia. Some of the recurrent themes of the ceremonies, songs and paintings described include the importance of the grinding technology in the use of *Acacia* seed as food, the traditional involvement of women with seed processing and the expansion of *Acacia* species from ritual centres scattered widely around Central Australia. That these ancient themes and precedents are still of considerable importance is supported by their continued ceremonial celebration. That they are now also depicted in the contemporary paintings of the area adds to their significance.

Conclusion

Central Australian Aborigines have developed a specific and substantial knowledge of *Acacia* and the ecology of *Acacia* dominated ecosystems. This knowledge has been the basis for the rational exploitation of these ecosystems and for their management by fire. There are still many Aboriginal experts who are the contemporary custodians of this cumulative body of knowledge.

Acacia trees and shrubs and the habitats that they formed were used by Aborigines in a diversity of ways to create secure and comfortable lives. But *Acacia* was important for reasons other than direct economic benefit. Species of the genus permeated the lives of Central Australian people and their languages and belief systems reflect this importance.

Many traditional economic and social aspects of Aboriginal–*Acacia* relationships are still relevant. The resumption of use of *Acacia* seed as food is one important area for investigation and development. If accepted by Aboriginal communities, the use of *Acacia* seed could lead to significant improvements in their health and economic independence.

There is currently widespread concern over the ecological change and environmental deterioration that has occurred in Central Australia during the last century. The lack of regeneration of long-lived *Acacia* species, particularly in the southern area of the study zone, is pronounced. This has been largely due to the combined over-grazing by rabbits and cattle. If this trend is not reversed it may lead to the virtual extinction of mulga and other tree species in some areas.

For Aborigines to be assured of a sustainable flow of benefits from *Acacia* species, the health and diversity of the Central Australian environment must be maintained. Although the ecology of the region has been disturbed by external factors for which there are no traditional prescriptions, it is only the Aborigines who have a history of rational and sustainable use of the area.

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LOWER MURRAY SHIELDS: AN HISTORICAL PERSPECTIVE

S. J. HEMMING

HEMMING, S. J. 1991. Lower Murray shields: an historical perspective. *Rec. S. Aust. Mus.* **24**(2): 125–138.

This paper traces the history of one element in the material culture of the Aboriginal people of the Lower Murray River region – the shield (Fig. 1).[1] The types of shields used in this area at the time of British colonisation are identified and the techniques used in their construction and the variations in their use are analysed. The engraved, and to a lesser extent the painted, designs on nineteenth century Lower Murray River shields are considered as providing the clearest identifiable examples of the art style of the region. The impact of British colonisation on the production and function of shields is examined and the survival of certain elements of this 'tradition' is discussed. A few shields are being made in the region today and the significance of this phenomenon is considered.

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British colonisation of the Lower Murray River region started in 1836 with the establishment of the colony of South Australia. At the time this area, like so much of temperate south-eastern Australia, did not have the elaborate painting traditions that characterised the north of the continent. What it did have, however, was a rich tradition of wood engraving. Today, the nineteenth century art of south-eastern Australia is best represented by weapons and other artefacts that the Aboriginal people engraved and painted in a variety of highly localised designs. The early interests of museums and other collectors were focused upon items associated with warfare. As a consequence, objects such as shields, spears and of course boomerangs, were mainly collected and have survived to the present day.

For the Lower Murray River region it is the shield which provides the most spectacular examples of the local art style. The engraved designs are the most complex element in the decoration and these were often highlighted with colours. The British artists George French Angas and William Cawthorne carefully recorded the distinctive forms and colours of Lower Murray shields in their watercolours of the 1840s (Angas 1846, Cawthorne 1844–64). Without these artists' records, knowledge of the ephemeral painted designs of this particular tradition would be very thin indeed.

When the British first arrived in South Australia, the peoples of the Lower Murray region were identified by a large number of local clan and language-group designations (Tindale 1974, Berndt & Berndt in press).[2] Today the majority of the Aboriginal people from this area, excluding the Adelaide metropolitan area, identify themselves as Ngarrindjeri people (Hemming, Jones with Clarke 1989). The Ngarrindjeri community numbers several thousand people, spread throughout the Lower Murray region. It is mainly members of this community who still produce wooden artefacts that can be traced back to the pre-European tradition of the region. However, the principal decorative elements of the 'Old People's' material culture, the engraving and painting traditions, have not survived.[3] In contrast, some of the basketry styles of this region have virtually survived intact. They were encouraged by missionaries as a civilised means of generating money for the missions and the Aboriginal people themselves. New forms of art are being developed in the community, combining new media with old skills and Aboriginal philosophies. Some Aboriginal people are also trying to revive the art of making old-style artefacts like shields, using information obtained from the South Australian Museum and early records.

Shields As Part Of The 'Old People's' Culture

Perhaps the earliest evidence of the existence of shields in the material culture of the Lower Murray region appears in a rock painting near Macclesfield in the Adelaide Hills (Mountford 1960: 468). It depicts human figures with various material possessions and at least one of the figures (A) appears to be carrying a shield (Fig. 2). Although there have been no dates obtained for the antiquity of this rock art, it is assumed by archaeologists that

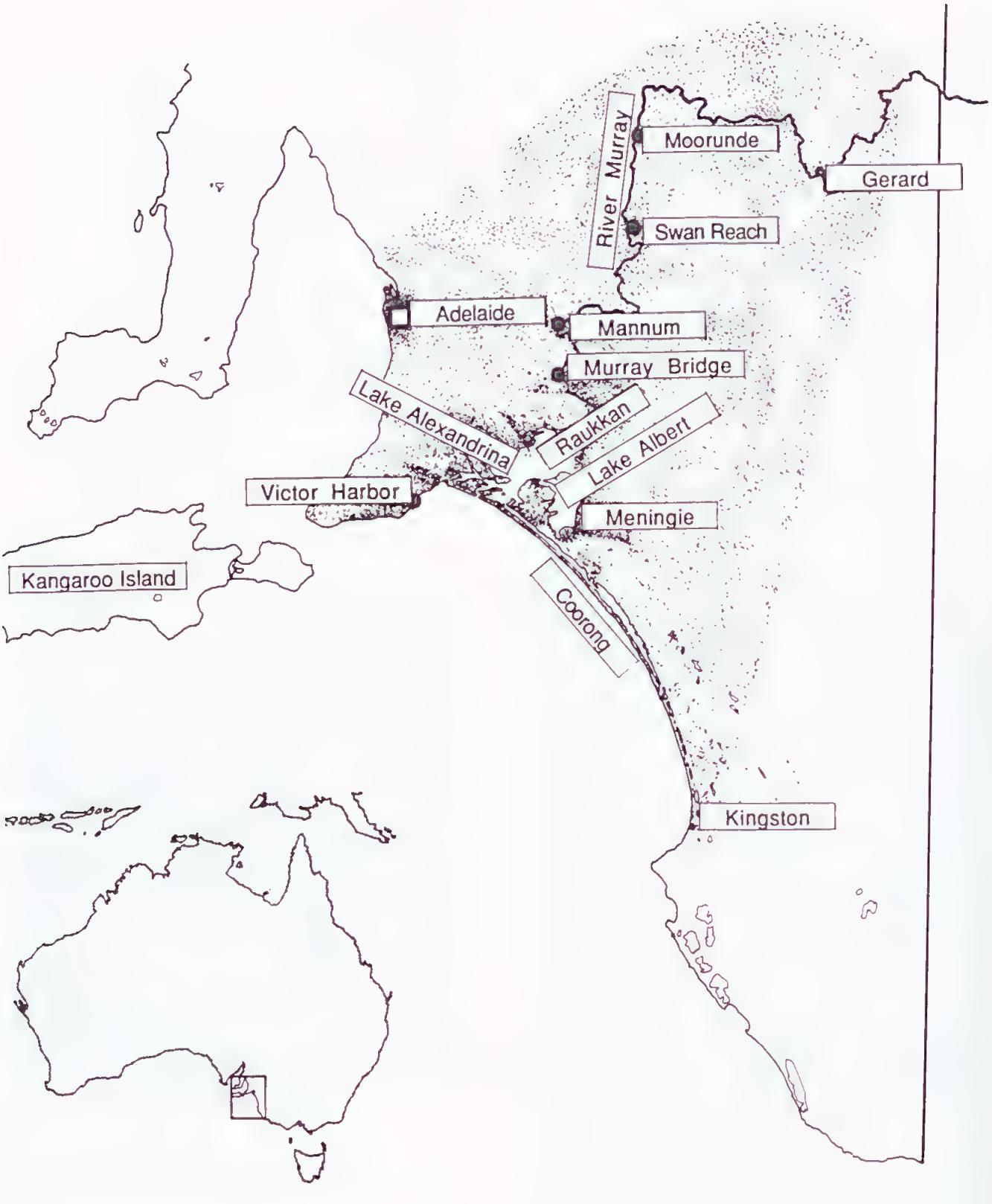

FIGURE 1. Lower Murray River region.

FIGURE 2. Figures from cave paintings in the Mount Lofty Ranges (after Mountford 1960).

it dates from a period long before British colonisation. This suggests that some elements in the material culture of this area were constant over a long period. However, it does not provide any evidence for a lengthy tradition of one particular style of art. There are certainly no apparent similarities between the style of decoration seen on the extant nineteenth century shields and the painting style found in this rock art.

In 1836 the Aboriginal people of the Lower Murray region were utilising three types of shields. These were the wooden parrying shield used in close combat and the wooden and bark spear-shields used to deflect spears and other weapons thrown from a distance. One of these, the bark spear-shield, was distinctive to the region. The combat in which these shields were used was highly ritualised and organised to settle disputes, which were most often between individuals and families. It bore little resemblance to warfare in the European sense, not involving heavy loss of life and usually stopping when a severe wound was inflicted upon one of the combatants (Fig. 3) (Stephens 1889: 477).

The bark spear-shield was decorated with predominantly painted designs and made from the bark of smooth barked eucalypts (Fig. 4). Angas' watercolour of South Australian Aboriginal men depicts two warriors with spear-shields (Fig. 5) (Angas 1844: AA8/10/8). The one in the top right-hand corner of the painting, a warrior from Mt Barker in South Australia, is holding a bark spear-shield. This variety of shield was often preferred in spear-fights to the wooden spear-shield, since it had the advantage that it was less likely to break when struck directly by a spear. The bark spear-shield is described in the following early account as only lasting for a very short time:

> The Wocaltee [bark spear-shield] is made and lasts but for a fight – for the bark soon loses its moisture, the sun warps it and so renders it unfit for use (Cawthorne 1926: 6).

Perhaps for this reason very few examples of these shields have survived. Their rarity may also be due to the vigour with which the early European authorities prevented spear fights in and around Adelaide and then seized and destroyed all the weapons (Cawthorne 1842–46: CY Reel 363, 623–625).

The other type of spear-shield used in the region was made from sap wood, the first layer of wood under the bark (Fig. 6). It was less likely to warp than a bark shield and of course it lasted longer. However, it was prone to breaking during fights, as the hardwood from which it was constructed was very brittle. Intricate engraving covered the faces of these shields and pigments were added to highlight the designs. In other parts of south-eastern Australia wooden spear-shields were most often used.

It appears that all groups in south-eastern Australia used the solid wooden parrying shield for defence against clubs and other weapons, during close fighting (Fig. 7) (Cooper *et al.* 1981: 32). In the Lower Murray region they were triangular in cross section and cut out of a solid piece of hardwood. Like the wooden spear-shields their faces were decorated with detailed engraved and painted designs (Fig. 8).

The best accounts of shield construction techniques describe the making of the bark shields of the Adelaide Plains area. In the early days of the colony Aboriginal groups from throughout the region travelled to Adelaide for a range of reasons including the distribution of rations and the availability of new articles brought in by the British (Foster 1989). This provided an opportunity for meetings between groups and at these meetings old disputes were settled and sometimes new conflicts arose and fights took place. As a result there were many opportunities for early observers, like Edward

FIGURE 3. Fending off spears with a shield, Adelaide area, *ca* 1844. Watercolour by William A. Cawthorne. Mitchell Library, Sydney (Cawthorne *ca* 1855, ML Z PXA 1490).

Stephens, to document the shield-making process. According to Stephens, the bark shields were made from eucalypt bark and were only obtainable during the 'spring of the year when the sap was flowing freely in the trees, and the bark could be readily taken off.' (Stephens 1889: 486). A handle was attached from the back and consisted of green pieces of wood pushed through holes in the centre of the shield. As the pieces dried they became very tight and formed a strong handle. The face of the shield was smoothed with stones and hardened with hot ashes. Once cool, it was covered with pipe-clay or lime, providing a smooth white surface on which red bands were usually painted.

By combining information on the shields of closely related areas in south-eastern Australia, we can assemble further detail about the techniques of manufacture and decoration of the two other types of shield used in the Lower Murray region. Baldwin Spencer, in his 1922 catalogue of the collections of the National Museum of Victoria, describes the method of manufacture of the wooden spear-shield of the Victorian region, which is made from the outer wood of the gum tree:

> . . . it is said that a mound of earth some 3 feet in length and about the same width as the shield is made; hot ashes are placed on the mound, and the slab of green wood on top of them; then sods of grass and stones are piled above it, and by the time that the ashes are cold the shield has assumed the curve of the mound (Spencer 1922: 17).

The parrying shields of the Lower Murray region were made from hardwoods and stone tools were needed for their initial shaping. Erhard Eylmann records the use of the Australian cherry *(Exocarpos cupressiformis),* at Point McLeay Mission in 1900.[4] George Taplin, the missionary who established Point McLeay in 1859, described this tree as possessing special powers in the eyes of the local Aborigines. They believed that if Australian cherry wood was burned then all the fish would leave the Coorong inlet (Taplin 1874: 90, Howitt 1904: 763–4). Perhaps they also believed that the inherent

FIGURE 4. Bark spear-shield, Point Malcolm, South Australia, *ca* 1840. South Australian Museum A2210 (66 × 48 cm).

powers of this wood strengthened the effectiveness of a shield.

In 1881 Dawson described the method of carving designs onto the faces of the wooden shields in western Victoria and stated that pieces of flint and volcanic glass were the carving tools (Dawson 1881: 25). Smyth describes another method of carving which involved the use of possum-tooth engravers (Smyth 1878, 1: 349). A possum jaw with a tooth still embedded was used to create designs on wooden surfaces. From an examination of the oldest shields from the Lower Murray region, this appears to be the primary engraving technique used in this region at the time of British settlement (Fig. 9). According to Cooper designs were often marked out first in straight sharp lines and then deeply engraved with the tooth engravers (Cooper 1975: 59).

The decoration of the bark shield was less involved than the decoration of the wooden shield. The majority of bark shields were painted with relatively simple designs and this was probably due to their ephemeral nature. The wooden ones, on the other hand, were intricately engraved and colours were also added (Fig. 10). The Aborigines obtained pipe-clay from the salt pans of the Lower Murray area to be used as white pigment. The red colours were created by using at least two materials, the ochres from the available mines in the area and a

FIGURE 5. An Adelaide warrior with a wooden spear-shield [left] and a Mount Barker warrior with a bark spear-shield, *ca* 1844. Watercolour by George French Angas. South Australian Museum Anthropology Archives, AA8/10/8.

FIGURE 6. Wooden spear-shield, Mannum, South Australia, *ca* 1855. South Australian Museum, A2283 (84 × 24.5 cm).

red dye obtained from a particular root (Stephens 1889: 487).[5] The bark shields were decorated with a complete cover of white pigment and then a variety of combinations of curved red bands. These shields were seldom engraved, but George French Angas, in one of his 1844 watercolours, provides an interesting example of one with engravings on its painted surface (Fig. 11). It has what appear to be kangaroo tracks, carved with quartz into the surface between the usual red bands.

Strangely enough the painted designs in this region bear no resemblance to the engraved ones. Curved bands are the most common element in the painted decoration, whereas angular lines predominate in the carving (Fig. 12). The painted designs seem to act as a visual deflector, focusing the eye of the attacker away from the centre of the shield. This would have been a useful quality for these shields in spear fights. Herring-bone, cross-hatching, zig-zag, chevron, lozenge, diamond, interlocking diamond and rhombic forms are the main design elements in the engraved decoration (Fig. 13). The wooden spear-shield in Fig. 14 is a classic example of the zig-zag design. The shield from Mannum (Fig. 6) provides a fine example of the use of the lozenge. There are few figurative motifs in the designs on the early shields, although this seems to have changed with the influence of contact with Europeans. Cooper writes:

> The gradual substitution of a complete range of new motifs for the old was an attempt by Aborigines – now [late 1800s] virtually dependant on European foods and other goods – to win an economic market for their wares. This trend towards naturalism and an increased figurative content has been observed as relatively common in the changing arts of 'conquered' peoples (Cooper *et al.* 1981: 38).

From an examination of the designs on the South Australian Museum's collection of Lower Murray spearthrowers, the majority of the motifs appear

FIGURE 7. Men fighting with clubs and parrying shields, near Point McLeay, South Australia, *ca* 1905. South Australian Museum Anthropology Archives, Chester Schultz collection.

FIGURE 8. Parrying shields, Lower Murray River, South Australia, *ca* 1880. South Australian Museum [left] A2300 (front and back; 96 × 13 cm), A2290 (85 × 9.5 cm).

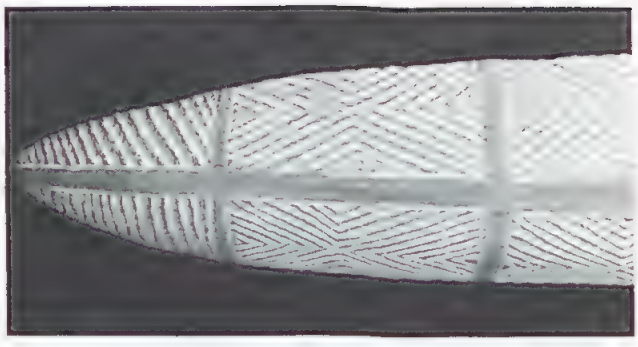

FIGURE 9. Detail of a parrying shield showing engraved designs that appear to have been made with a possum-tooth engraver. Lower Murray River, South Australia, *ca* 1880. South Australian Museum A2298.

to be figurative (Fig. 15). These examples may have all been influenced by European contact. However, for this region there is not enough evidence to reach any conclusions on this issue.

Like other 'traditional' Aboriginal art, the painting and carving of this region most certainly had a personal and social link with the maker. Even though the meanings of the designs of the Lower Murray region have been lost for several generations, the fact that they had a specific meaning and that they belonged to particular groups is still recognised. Henry Rankine, the 1990 Chairperson of Point McLeay Community Council, made this point very strongly in a meeting with South Australian Museum staff in 1987. He was

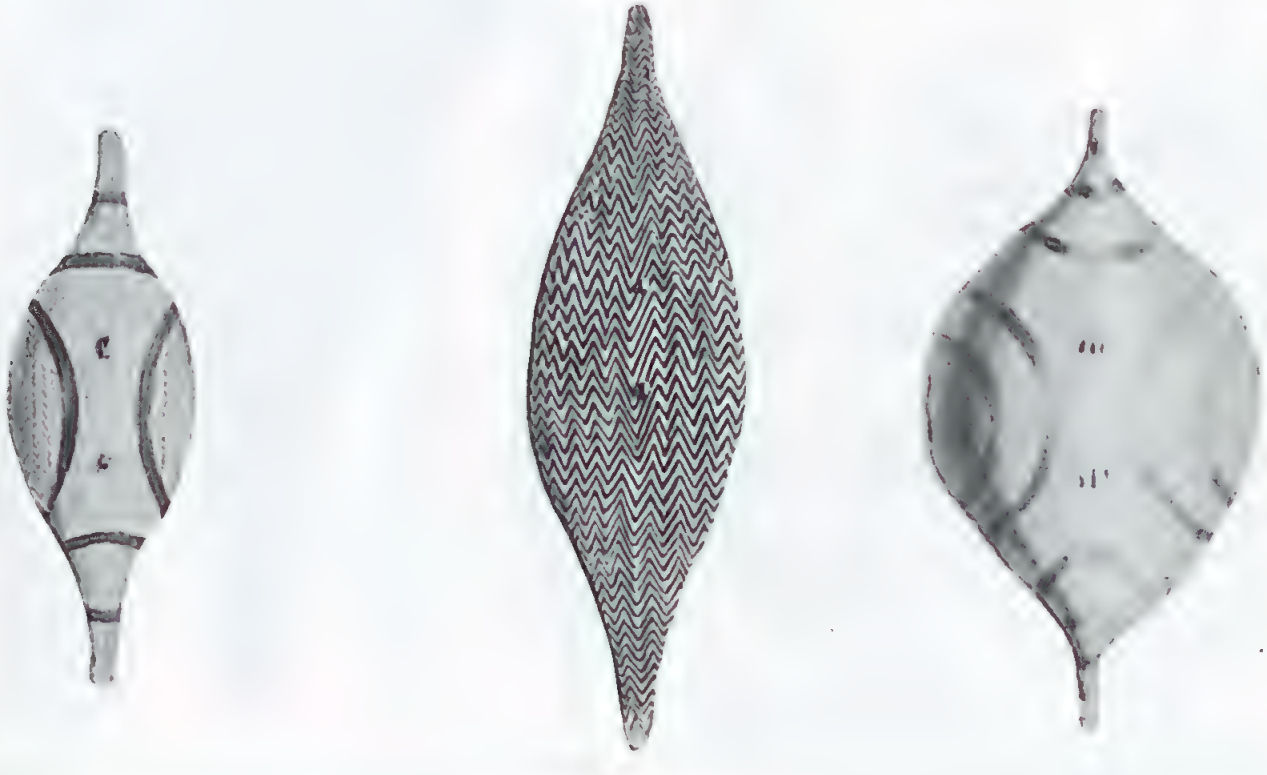

FIGURE 10. Spear-shields, wood [left 2] and bark, Lower Murray Region, South Australia, *ca* 1844. Watercolour by George French Angas. South Australian Museum Anthropology Archives, AA8/10/2.

FIGURE 11. Bark spear-shield decorated with painted and engraved designs. Watercolour by George French Angas, *ca* 1844. South Australian Museum Anthropology Archives, AA8/10/16.

FIGURE 12. Examples of designs on bark spear-shields, Adelaide area, *ca* 1840. (After Stephens 1889).

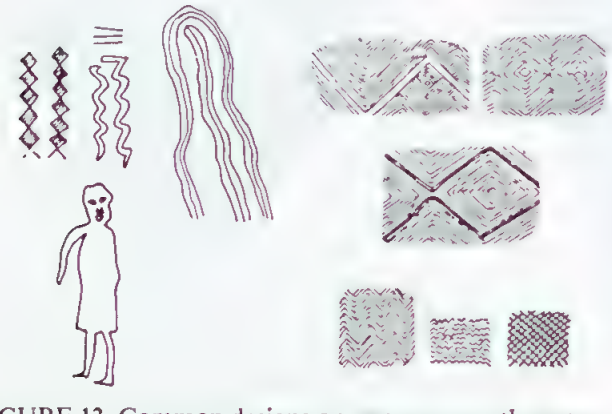

FIGURE 13. Common designs on weapons, south-eastern Australia, mid 1800s. (After Brough Smyth 1878).

FIGURE 14. Wooden spear-shield, Moorunde, South Australia, *ca* 1850. South Australian Museum, A42736 (94 × 27 cm).

commenting on his grandfather Clarence Long's shield, which was made in the 1930s for Norman B. Tindale, curator at the South Australian Museum (Fig. 16).[6] Henry Rankine knows the area from which his grandfather originated and he argued that the designs on the shield must relate to this place.

Some evidence to assist with the interpretation of the meanings of the designs on the shields from this area can be obtained by comparing information available relating to similar designs in other parts of south-eastern Australia. A mortuary carving made as a memorial for an important Aboriginal man from the Yarra area of Victoria, was capable of interpretation by other members of his group and illustrates something of the meaning of the artwork (Barwick & Barwick 1984: 9–11). It is interesting to note that the designs on one of the spearthrowers in Fig. 15 includes very similar human-like forms to the shapes on this mortuary carving from Victoria. Much the same as the art of the northern Australian bark painting and the Western Desert acrylic, the designs on Lower Murray region shields probably related to the artist's important 'Dreaming' sites.

Survival Of The Shield-Making Tradition Until The 1930s And 1940s

The shield-making tradition of the Lower Murray region continued in a modified form until the 1930s and 1940s. Of the designs used to decorate the shields, the painted designs used on the bark spear-shields appear to have survived the longest. Clarence Long's South Australian Museum examples are probably the last to have been made (Fig. 16).[7] He also made a parrying shield in the early 1930s which was obtained by the Museum in 1979 (Fig. 17). It is not decorated and gives a good indication of the period when carved designs were no longer used. Clarence Long was an initiated man, one of the last for the area, and if the intricate engraved designs used on the wooden shields had not been forgotten by the 1930s, then men like Clarence Long had made the decision that they could no longer be used, perhaps due to their 'sacred' nature. Lindsay Wilson, a Ngarrindjeri man, remembers as a child helping Clarence Long with artefact making at Point McLeay. He remembers Clarence Long burning the design of an owl onto shields that he sold to tourists brought to Point McLeay on paddle-steamers. In Tindale's 1937 film on basket making the owl is identified as being Clarence Long's

FIGURE 15. Designs on spearthrowers, Lower Murray Region, South Australia, mid to late 1880s. South Australian Museum, [left] A54461, A3998, A3999, A15355.

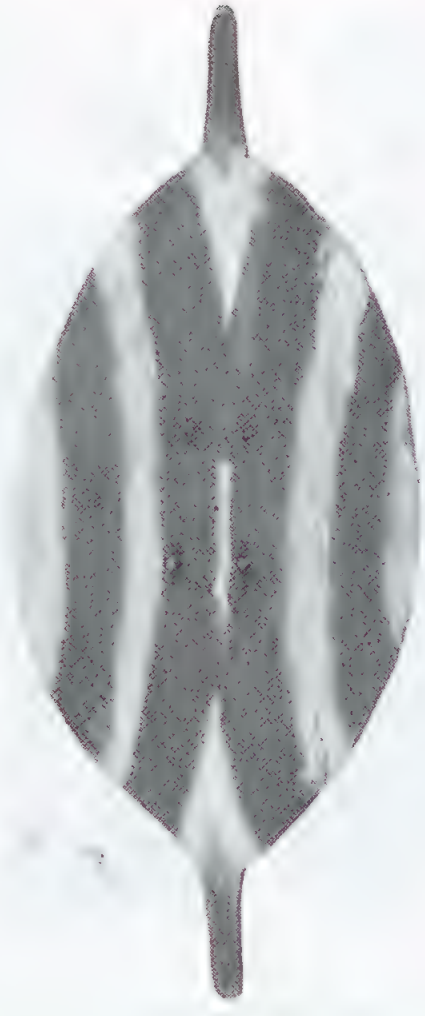

FIGURE 16. Bark spear-shield, Clarence Long, Coorong, South Australia, 1932. South Australian Museum, A17537 (67 × 26 cm).

FIGURE 17. Clarence Long [left] holding a parrying shield and Gollan Seymour, Point McLeay, South Australia, *ca* 1933. South Australian Museum Anthropology Archives, AA326.

ngaatji or totem (Tindale 1937). An engraved boomerang (A66883) in the South Australian Museum's collection, made in the early 1930s by another Point McLeay man, Gollan Seymour, is decorated with motifs carved in low relief which were common in that period and are based on the style of designs on the coins of the time (Tonkin 1933–4). They depict the hunting of different animals. Aboriginal people in this period made boomerangs for sale and for use in demonstrations of their famous ability to return when thrown.[8]

To some extent the shield-making tradition survived for as long as it did because of the interest shown by tourists, curio hunters and museums. Bellchambers was a South Australian naturalist who regularly visited the Lower Murray area through the late 1800s and early 1900s. He said the following about the history of weapon making in the area:

> This [the double-pointed fishing spear] was the last of the native weapons to disappear from general use, although it lingered well into the eighties of last century. About that time I saw young fellows training in the use of both light and heavy hunting spears; but, like the longbow of the British, these weapons were now looked upon more as a means of sport. The manufacture of weapons is still carried on in a desultory manner by the survivors [*ca* 1910], more for the purpose of sale to relic hunters (Bellchambers 1931: 21–22).

Lindsay Wilson says that before his time (prior to the 1920s) Point McLeay had a sportsday when spearthrowing and other old skills were tested. This event took place near the old jetty on the shore of Lake Alexandrina. Shields may well have been used during these sporting occasions.

Many of the earliest shields in the South Australian Museum's collection come from the Point McLeay Mission and were most likely being made specifically for sale. Some date back to the period of the first missionary, George Taplin, who founded the mission in 1859 (SA Museum Anthropology Register). This link between the Museum and the region was continued and several parrying shields were obtained for the collection in the late nineteenth century. The unique collection made by Erhard Eylmann in 1900, now a part of the holdings of the Ubersee-Museum in Bremen, provides a clear indication of the styles existing in the area at the time (Eylmann 1900). From an examination of this collection it is clear that men

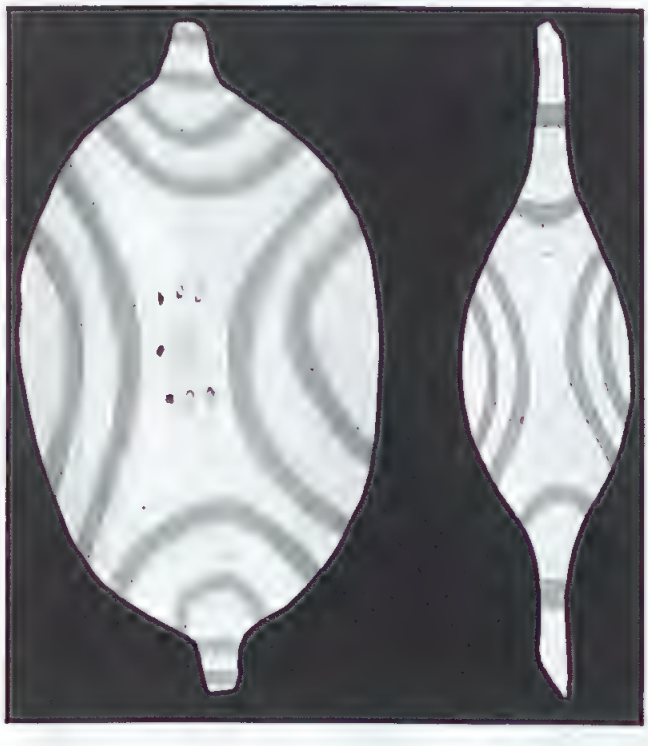

FIGURE 18. Bark spear-shield [left], Joseph Koolmatrie, Point McLeay, South Australia, 1914. South Australian Museum, A1001 (74 × 43 cm).

FIGURE 19. Recent bark spear-shield, Paul Kropinyeri, Mount Barker, South Australia, 1987. South Australian Museum, A65245 (91 × 24 cm).

at Point McLeay were using metal tools to make their shields (Hemming 1986). They decorated them with new, simplified geometric designs and highlighted them with introduced colours like blue.

In 1914 the South Australian Museum acquired one of its few examples of a bark spear-shield. It was made by Joseph Koolmatrie of Point McLeay (Fig. 18). It appears from a letter that he wrote to Edward Stirling, the Museum's Director, that he made it specifically to sell to the Museum (Luebbers 1984: A1001). In the 1930s Tindale acquired two similar shields from Clarence Long (see Fig. 16). These were probably among the last spear-shields to be made in the area until the 1980s. Tindale was anxious to collect examples of the material culture of the Lower Murray area and in the 1930s he worked with several Aboriginal people who were keen to preserve a record of their pre-European culture (Pretty & Tindale 1978: 9). Clarence Long was Tindale's main informant and he made many items for the Museum's collection, based on his experiences in his younger years.

By the late nineteenth century shields had little practical value to Aboriginal people in the Lower Murray region. The traditions that required the use of shields had been destroyed by the impact of British colonisation. A small demand for these objects came from private collectors and museums. However, once the knowledge of the significance of the designs on the objects like shields was lost, and innovations were attempted, this limited market lost interest, with collectors and museums sharing the view that these objects were no longer 'authentic' Aboriginal artefacts.

Revival Of The Shield-Making Tradition

During the 1980s there have been several Aboriginal people making shields in the Lower Murray region. However, this is not a direct continuation of the shield tradition of this area. These artists are all descended from Lower Murray people, but their knowledge of shield-making has almost entirely come from European records of Aboriginal culture or from actually looking at objects in the South Australian Museum. In fact, the collection policy of Museum anthropologists like Tindale has proven to be very useful for people interested in reviving a lost tradition. These wood-carvers bring with them a knowledge of the suitable local woods in their own areas and of wood-carving techniques in general. Clubs for hunting rabbits, and boomerangs usually made for sale, have occasionally been made in the region up to the present day.

John Lindsay, a wood-carver from Gerard Aboriginal Community in South Australia's Riverland, makes small-scale sets of weapons that include shields. He says that he saw one of the old people making these when he was younger and with information he obtained from the South Australian Museum, he decided to try to replicate these sets. In 1983, Colin Cook (the Chairperson of Gerard Aboriginal Community) and John Lindsay contacted the South Australian Museum and asked for information about the material culture of the people who occupied the Gerard area at the time of European contact. They explained that most of the people living at Gerard have no 'traditional' links with the area and that knowledge of the local material culture had almost completely disappeared. They wanted, however, to start making objects that were distinctive to the region. The Museum supplied information gathered by explorers and other early observers and the carvers used it as a guide for making sets of weapons based on the pre-European material culture of the region.[9] Although Lindsay and Cook did not have an understanding of the carved and painted designs on the objects that they were attempting to copy, they still considered that these designs were the property of their original makers. For this reason the artefacts produced during this project were not decorated and it was therefore felt by the carvers that an offence under Aboriginal law had not been committed.

Both Lindsay and Cook had prior experience with making boomerangs and clubs. The techniques that they knew were a combination of the woodcarving skills of their ancestors, the river Aboriginal people and Aboriginal people from the West Coast and north-western regions of South Australia. These different groups were brought together partly as a consequence of the Government, in the early 1950s, moving people from the Ooldea area to the newly formed Gerard Mission. Many of the people who had been living at Swan Reach Mission further down the River Murray had already been moved to Gerard when the former was closed in the late 1940s.

To some extent Lindsay and Cook's idea to produce replicas of pre-European material culture from the Riverland was an attempt to establish a cultural link with the area. They told me that they were often asked about Riverland Aboriginal culture by tourists and other visitors and that they felt a sense of inadequacy in not being able to answer their questions. Making the weapons gave them something tangible connected with Riverland culture to show visitors and members of their own community. However, it also gave them a personal link with the culture of the Riverland Aboriginal people, the prior owners of the land on which Gerard Community is situated.

Paul Kropinyeri, who indentifies as a Ngarrindjeri, is another craftsperson who makes

and sells wooden artefacts. He produces decorated boomerangs and other weapons and has an interest in making replicas of 'traditional' weapons. His particular speciality is the bark spear-shield of the Lower Murray region (Fig. 19). Many of his wood-carving skills were learnt through watching old people when he was young. He has also undertaken considerable research into the old styles and has inspected the South Australian Museum's collection of Lower Murray shields. As a descendant of the people of this region, he has an interest in recreating its weapons and art style. He decorates his bark spear-shields with painted designs based on the classic style. He has also experimented with making parrying shields and wooden spear-shields which are decorated with engraved geometric designs.

The South Australian Museum shop is one of Paul Kropinyeri's main outlets and the principal clientele are overseas and interstate visitors. His shields have also been useful to the Education Department and the Museum's education and information sections have purchased examples for teaching purposes. The Ngarrindjeri community at Meningie, on the shores of Lake Albert, has obtained several of his shields as a cultural resource to be used in discussions about the Aboriginal culture of the area. This community is actively involved in educating their younger people and the general community about Ngarrindjeri culture and history. They run a cultural camp called 'Camp Coorong' which has its own museum and they work in schools and with local community groups. Ngarrindjeri community leaders in Meningie, like George Trevorrow, see shields and other artefacts as being valuable teaching resources and important symbols of Ngarrindjeri culture.

The revival of Lower Murray art and craft has generally been supported by the local Aboriginal communities and there has been a growing sense of pride in these traditions. This attitude has not always been present. In the southern areas of South Australia, from the 1950s to the 1970s, there was a movement of people away from the former missions and rural areas, and into Adelaide (Gale 1972). Economic opportunities and government policies encouraged Aboriginal people to move into the major cities. The pressures that many missionaries had placed on Aboriginal people to give up their own culture were, in fact, being continued in a different form. During this period of 'assimilation', the practice of encouraging the younger generation to be ashamed of Aboriginal culture was continued by the authorities and one result was that few took an interest in the old arts and crafts. Since the 1967 Australian Constitutional Referendum, Aboriginal people have had increased control over their own affairs and through new employment opportunities in State and Commonwealth public services, their views have had a direct effect on government policy. There has been a corresponding growth in the understanding and appreciation of Aboriginal culture in the wider community. Albert Namatjira's central Australian landscapes, Arnhem Land bark paintings and Western Desert art have created an interest in Aboriginal art and this has provided – at least since the 1980s – a growing market for the art and craft of the Lower Murray region. Innovation, however, is still something upon which the majority of potential buyers frown, although, with the 1989 opening in Adelaide of the Aboriginal Cultural Institute (Tandanya), there has been increased acceptance of contemporary urban Aboriginal art and the strength of innovation.

This new interest has been promoted, for example, by exhibitions like Bluey Roberts' (a Ngarrindjeri artist) 'River Spirit Dreaming: The Art of Bluey Roberts' (Aboriginal Cultural Institute 1990). As part of this major exhibition he produced a large-scale piece of artwork featured on the footpath in front of the Tandanya Centre. He is both a painter and a carver and his work most often involves interpretations of his relationship with the environment and the Dreaming. One of his specialities is large boomerangs decorated with incised and burnt designs (Sutton *et al.* 1988: 189). In his art he is very conscious of the value of continuing traditions. This is well illustrated by his interpretation of a carved walking stick that he sold to the South Australian Museum in 1985. The handle is a human hand 'hanging on to the culture, . . . hanging on to it as much as I can'. The shaft of the walking stick is a snake, decorated with painted animals, the snake and the animals representing the culture. However, unlike the revival-based activity of making shields, which has only a minor role in present day Aboriginal culture, Roberts' art is a functioning part of contemporary Aboriginal culture. It combines the past with the present and presents a new urban Aboriginal philosophy of life.

Conclusion

In a period when the strengthening of Aboriginal identity is a central concern in south-eastern Aboriginal communities, the revival and development of local arts and crafts is providing one of the foci in this process. This phenomenon has followed several decades in which wooden works by Aboriginal people of this region were largely restricted to hunting clubs, which they used themselves, and returning boomerangs, which they sold on the curio market. The wood-carving tradition in the Lower Murray River region had been

almost totally destroyed by the effects of British colonisation. In particular, the region's style of engraved and painted designs – the 'art' tradition – did not survive, even in a changed form, much past the Second World War. Discontinued first were the intricately decorated objects. Their place was in the religious ceremonies and in ritual warfare. It was these cultural activities that were the most affected by the impact of British colonisation. Consequently, little is known among contemporary groups of the ceremonial body painting style of this area, the decoration of ceremonial objects, or the meaning of the designs on the weapons such as shields.

In 1990, however, there is a growing number of Aboriginal artists working in the Lower Murray River region. Some like Bluey Roberts are gaining Australia-wide recognition. It is in the area of contemporary urban art, rather than in the production of 'traditional' artefacts like shields, where the most significant impact on Lower Murray culture is occurring. In the 'new' art tradition important contemporary issues are being explored such as urban Aboriginal identity. Artists who make shields do so mainly for a restricted educational market and for museum and cultural centre collections.

Acknowledgments

Much of the information gathered for this paper resulted from research and fieldwork associated with the development of the South Australian Museum's *Ngurunderi* exhibition. During this period of several years I have been taught about Lower Murray Aboriginal culture by many Aboriginal people. I wish in particular to thank Henry and Jean Rankine, George, Tom and Ellen Trevorrow, Ron Bonney and Lola Cameron-Bonney of Kingston, Lindsay Wilson, Bluey Roberts, and Doreen Kartinyeri who works with me at the South Australian Museum. John Lindsay, Colin Cook and Paul Kropinyeri, the contemporary artists mentioned in this paper, have also been very helpful.

Philip Clarke has been working with me on Lower Murray Aboriginal culture for several years and his expertise in the area of ethnobiology has been particularly valuable. I am grateful for comments on various drafts on this paper made by Philip Clarke, Robert Foster, Chris Anderson, Peter Sutton, Leonn Satterthwait and John Stanton.

The photographs of specimens were taken by Michael Kluvanek.

Endnotes

1. This paper is an expanded version of a section of Survival, Regeneration, and Impact (Chapter 6) in 'Dreamings: The Art of Aboriginal Australia' edited by Dr Peter Sutton.

2. Professor R.M. Berndt and Dr N.B. Tindale have both carried out detailed research with the people from this region. They generally agree on the names of the groups of people occupying this area at the time of contact, i.e. Tangane, Yaralde etc.

3. I borrow the label 'Old People' from Ngarrindjeri people today who use it in a number of ways. Sometimes as a term for today's older Ngarrindjeri people, but also, very often, for the people who lived according to the traditions of the pre-contact Aboriginal culture.

4. This information is included on a label for a shield in the Eylmann collection held in the Ubersee Museum in Bremen, West Germany.

5. Perhaps the most important mine in the region was at Ochre Cove, near Port Noarlunga. The root mentioned by Stephens has been tentatively identified in a recent article as *Drosera whitakeri* (Clarke 1987: 67).

6. Dr Norman Tindale worked at the Museum until his retirement in 1965. He gathered extensive information about the culture of the people of the Lower Murray area in South Australia. Much of this information will be presented in a book he is working on about the Aborigines of southern South Australia and it features the life of Clarence Long, his main Aboriginal informant.

7. Clarence Long made two bark spear-shields for the South Australian Museum's collection, A17537 and A17538.

8. In the late 1930s and early 1940s Professor Ronald Berndt worked with Albert Karloan, an initiated man of the Yaralde people of the Lower Murray region. In conversations with Berndt he describes Karloan's shame at having to give boomerang throwing demonstrations to tourists as a means of making a living. It is ironic that many Ngarrindjeri people today remember Albert Karloan for his skills at throwing the returning boomerang, not for his great knowledge of the Aboriginal culture of the Lower Murray area. This will no doubt change with the publication, jointly with Karloan, of Berndt's book on Yaralde culture (Hemming, personal correspondence).

9. Provision of the information sought by John Lindsay and Colin Cook was organized at the South Australian Museum by Graeme Pretty, Curator of Archaeology.

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LOCATING ABORIGINAL SITES: A NOTE ON J. G. REUTHER AND THE HILLIER MAP OF 1904

L. A. HERCUS & V. POTEZNY

HERCUS, L. A. & POTEZNY, V. 1991. Locating Aboriginal sites: a note on J. G. Reuther and the Hillier map of 1904. *Rec. S. Aust. Mus.* 24(2): 139-151.

This paper provides a critique of the detailed map of Aboriginal sites in the eastern Lake Eyre region which was prepared by H. J. Hillier at Killalpaninna Mission in 1904. Research has shown that while most of the 2468 named sites can be connected with recorded mythological events, the map cannot be used satisfactorily as a topographic guide to these sites unless supplemented by Aboriginal traditions. This principle is illustrated by specific examples drawn from fieldwork undertaken by the authors.

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The Lutheran missionaries on the Lower Cooper Creek, South Australia, made a major contribution to the knowledge and understanding of Aboriginal mythology and sites in the Lake Eyre basin. The best known work emanating from Killalpaninna is the vast manuscript written by Pastor Johann G. Reuther around the turn of the century, now available in the translation by Scherer in microfiche edition (Reuther 1981). Practically all the thirteen volumes, even the dictionary, have references to place-names and to sites. Particularly important from this point of view are Volume X which deals with mythology and the two volumes (XII and XIII) on the famous *toas* or so-called 'direction posts' (Jones & Sutton 1986). The bulk of the information on place-names is to be found in Volume VII, which contains 2468 entries.

Nearly all the 2468 place-names listed by Reuther in Volume VII were added to the then current 1: 500 000 map by Henry J. Hillier who arrived at Killalpaninna in 1894 and subsequently became the mission schoolteacher. Hillier and Reuther had the great advantage that in their day Aboriginal geographical knowledge of the north-east of South Australia was intact: older people who had come to Killalpaninna from different parts of the region all knew their respective 'country' in minute detail. They were obviously willing to give information. R. B. Reuther described to Tindale (Jones & Sutton 1986: 52) how his father, Pastor Reuther, only had to go out to the nearest sandhill and call 'Cooee' and 'half an hour afterward you'd see all these old fathers come in', and 'they would be talking about one word for a terrible long time'. So with accomplished speakers who contributed all the information for the work, Reuther (in collaboration with C. Strehlow), produced a translation of the New Testament into Diyari (Reuther & Strehlow 1897), he produced grammars and a voluminous Diyari dictionary, as well as an annotated list of personal names, the two volumes of descriptions of *toas*, and comments on the places to which these objects refer. Hillier produced the map which is now held in the South Australian Museum Anthropology Archives (AA263) (Fig. 1). It looks as if we could simply go out and follow the map, use the information from the volumes and locate all the important Aboriginal sites in the north-east of South Australia. This would be a remarkable step forward, in terms of knowledge and conservation of sites. Future maps of the region would have a significant Aboriginal content. Unfortunately this is too good to be true.

The aim of the present paper is to show that matters are not so easy for the following reasons:

1. There are internal inconsistencies and inevitable inadequacies in the various volumes of the Reuther manuscript. Specialised knowledge, found only in Aboriginal traditions, is necessary for their successful interpretation.
2. There are practical difficulties which in most cases make it impossible to locate sites from the map.

Internal Inconsistencies

The place-names volume is of quite a different order to the volume on mythology. Volume VII gives explanations of the place-names usually based on the day to day activities of minor ancestors — where they saw particular plants growing or hunted for various animals, noticed tracks or made sundry comments. Volume X however, deals with major myths or sections of myths, and there is very little

FIGURE 1. Detail from H. J. Hillier's 1904 map of Aboriginal place-names in the eastern Lake Eyre region. Underlining indicates that the site has been located, as identified in Fig. 2. S.A. Museum AA266.

Ngaljkarini.
Ngaljkarini.
Karangantji.
Munkirra.
Munkirra.
Ngalbura.
Piraka.
Tarukurlijindrini.
Pitjipiljla.
Wonapardi
Pitipilkana.
Panapandi.
Ngapurunga
Mudlakuntja.
Wintiworani.
Pandibana
Tipara.
Marakantingamani.
Ngoriljа
Wirpini.
Harawinmjla.
Ngaraljminka
Tarurunu.
Tulatapa.
Dilkamandrabadu.
Tjimpiri.
Pajatura.
Ngarduparta.
Julkupilla.
Dakadaka.
Turupinka
Ngardupada.
Milimpiri.
Tarutuda.
Miljita.
Pajaturu.
Kaltjakaltja.
Pirramuntji
Purima.
Tajitapa.
Pajamaterijpiri.
Munutata.
Kirlinkirli.
Kudnamuru.
Wasawaku.
Muramuramandrantjami.
Marnwulu.
Wiluranta.
Kanapitidunkanami.
Mankaragildigilli.
Pajaburru.
Mandiwarli.
Pajamarda.
Tuliri.
Kirikinga.
Pajawirini.
Kalpirituda.
Matilgawra.
Waltirimana.
Kandirita
Kirla.
Kudnampirra.
Palkurakadiwarili.
Danpara.
Pirrana.
Wadika.
Tirpakurli.
Dantitu.
Ngapadirtji.
Wunduwundu.
Paiwonki.
Kalatjarkina
Kujapati.
Jerpawarili.
Ngapabulu.
Duldara.
Pundudunda.
Malkamalkawulu
Ngurlaworda
Duntjara.
Marumakapari.
Pitibaburitji
Kutukumazi.
Nakara.
Mitindiminka.
Kuntimiaka.
Kunkamaxamiaka.
Wonpirkaturara.
Tulatapa.
Paringandri.
Pirigildi.
Kurlanta.
Wirlaminтji.
Ngarduparta.
Julkupilla.
Jidiburuna.
Tjalparaworani.
Kaltjakaltja.
Pajaturu.
Kokukaka.
Mirandjerki.
Jerramangani
Mirindikurara
Kudnamuru.
Kirlinkirli.
Wasawaku.
Muramuramandrantjami.
Marnwulu.
Wiluranta.
Kanapitidunkanami.
Mankaragildigilli.
Munara.
Woramjijirbamalina.
Wapiwapilara.
Kudakudaku
Kudna
Wiparawordu.
Womatunda.
Pangalati.
Kildimara.
Dilkumaratji.
Tildirka.
Nyatatanda.
Rokunka.
Patikimpa.
Pitiwirawira
Kudnampirra.
Wadika.
Tirpakurli.
Kudnabuju.
Worakalina
Kirarapadi.
Ngapabulu.
Jerpawarili.
Duldara.
Kalatjarkina
Kujapati.
Pundudunda.
Malkamalkawulu
Kutukumazi.
Nakara.
Mitindiminka.
Kurkaminka.
Wuldumara.
Kuparu
Pirkako.
Karlatjerki.
Padipandra.
Kalariwora.
Kundri.
Mankiri.
Kujumarekati.
Kurtjara
Marumama
Kawolkatjari.
Milkipada.
Wapilanta.
Wonduru
Maddatjarla.
Tjutjupantji
Kandikandiwarinja.
Mardapinka.
Tarru
Ngapadanti

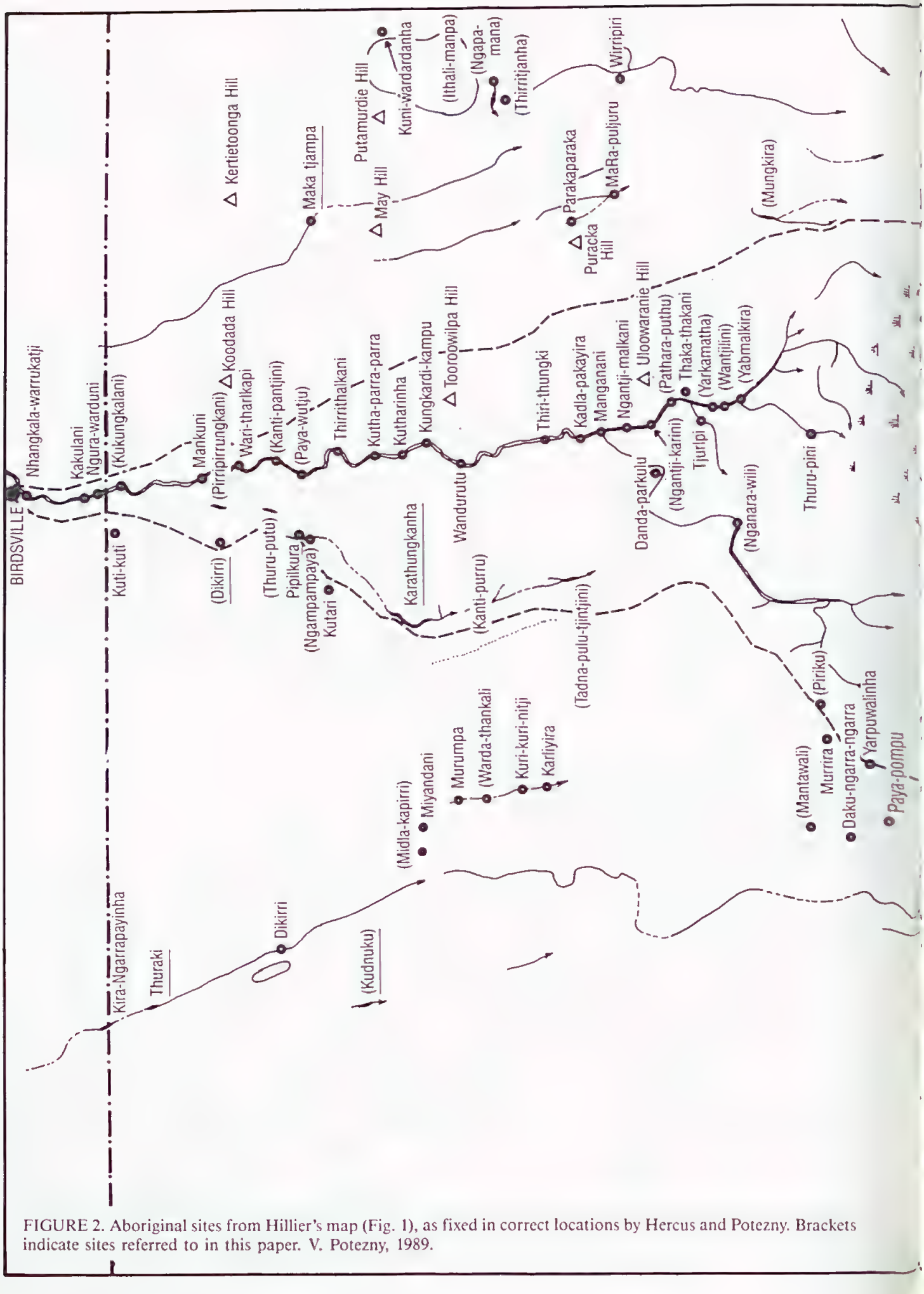
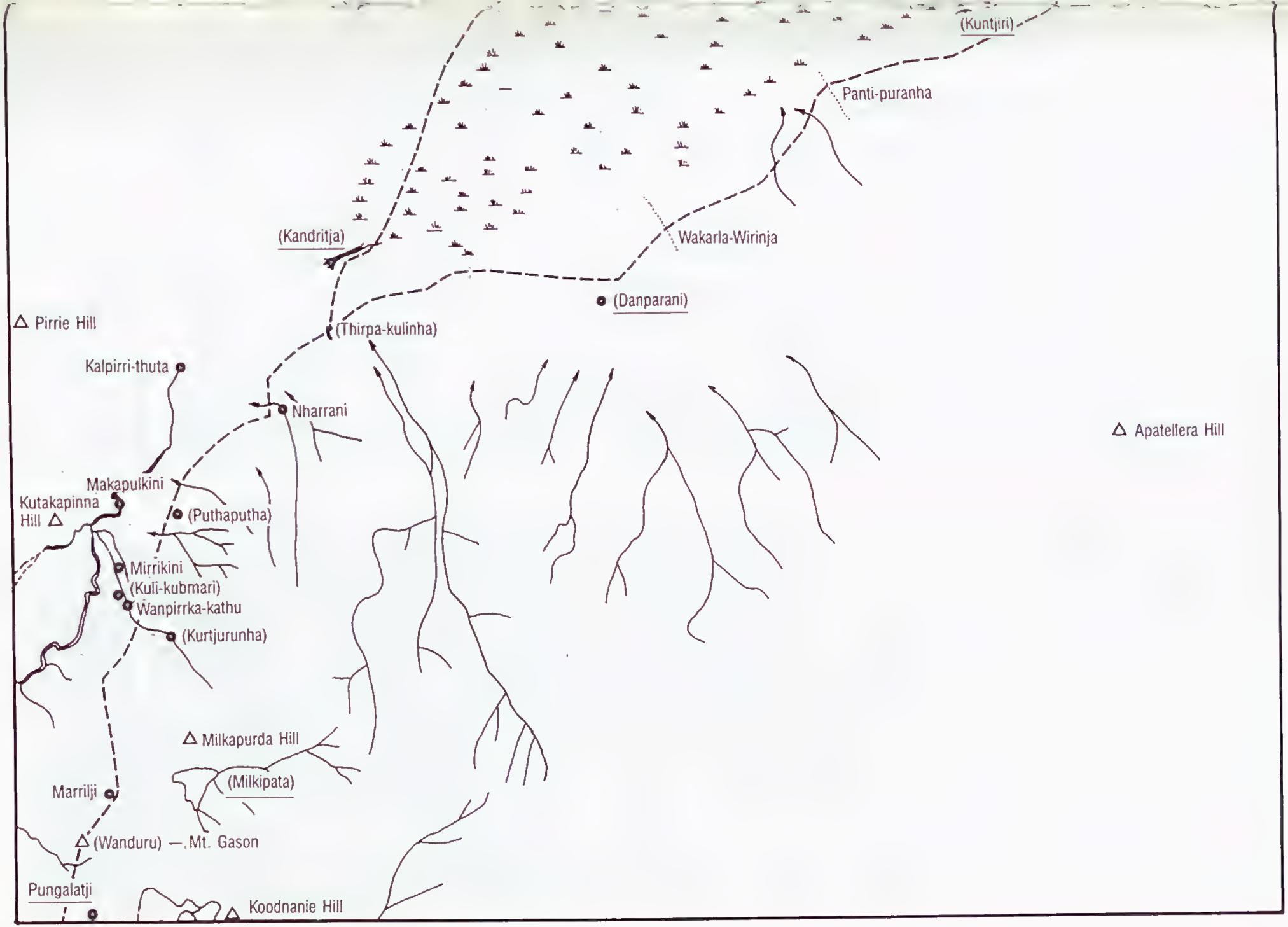


FIGURE 2. Aboriginal sites from Hillier's map (Fig. 1), as fixed in correct locations by Hercus and Potezny. Brackets indicate sites referred to in this paper. V. Potezny, 1989.


(Kuntjiri)
Panti-puranha
(Kandritja)
Wakarla-Wirinja
(Danparani)
Pirrie Hill
(Thirpa-kulinha)
Kalpirri-thuta
Nharrani
Apatellera Hill
Makapulkini
Kutakapinna Hill
(Puthaputha)
Mirrikini
(Kuli-kubmari)
Wanpirrka-kathu
(Kurtjurunha)
Milkapurda Hill
(Milkipata)
Marrilji
(Wanduru) — Mt. Gason
Pungalatji
Koodnanie Hill

connection between the two volumes. This disjunction can best be illustrated by two examples.

i The story of the Erotic Green Snake

One of the stories told in detail by Reuther in the mythology volume is that of a Snake Ancestor whom he calls 'Marikilla', (Volume X: 114–123). This is equivalent to *marrakila*, the Diyari word for 'green snake', *Pseudechis australis* (Johnston 1943: 290). Reuther also gives this Ancestor the names 'Ngaltimpara', and 'Ngurapata'. There is very little in his text that gives us an idea of location; only four places are named:

1. 'Ngamara', 'a tall and stout tree', which is said to be far away to the north.
2. 'Burinapalkitutu', 'first to lie down and then to go on', where he left his mob behind.
3. 'Mudlakubmari'.
4. 'Warankirpamalini' or 'Warangijiribamalina'.

Of these four only two appear in the place-names volume. The first is 'Ngamara':

No. 1443 'Ngamara' Judlajudlanja.
Meaning 'thick bush, scrub'.
This is the name of a district. It is mainly overgrown with trees and shrubbery, wherefore it has acquired the above name. This area is the Province of the Kankuwulana.

The translator (Scherer) has added a comment on 'Kankuwulana': 'this is Reuther's first reference to this tribe'.

'Kankuwulana' however is not the name of a tribe; it is a Diyari word, *(kanku-wurlanha* in P. Austin transcription, Austin 1981) and it means 'the two boys'.

The second Green Snake site to appear in the place-name volume is 'Mudlakubmari'. This name means 'nose-blood' in a mixture of Wangkangurru and either Diyari or Ngamini: *kubmarri* is Wangkangurru for 'blood', but *mudla* 'nose' is Diyari and Ngamini. There are two entries for this. No. 1069 is said to be from Wangkangurru and refers to the Ancestor 'Palungipina' beating his two sons to death. 'Palungupina' belongs to the Simpson Desert and to Pirlakaya Well in particular. The entry seems to have no locational relevance to the story of Marakilla. There is also no. 914 which is said to be in Diyari country and again has no evident connection. It refers to the Ancestor Darana's dog having a bloody nose from digging a hole.

The combined evidence of Reuther's volume on myths and the list of place-names therefore leaves us with no proper location. Even with the combined evidence of Volumes VII and X and the Hillier map we remain quite unable to relate the story of Marikilla to the landscape.

There seemed no hope of learning more. The story belonged to Ngamini people, and Dinta, the last traditionally knowledgeable Ngamini, had died in Marree in 1964, shortly before L. Hercus's first visit. Fortunately however three Wangkangurru people knew the myth of what they called *Kurkari,* the ancestral Green Snake. *Kurkari* is simply the Wangkangurru name for the species of snake that was called 'marrikilla' by Reuther's Diyari informants. Mick McLean, a senior Wangkangurru man, had heard the myth from Dinta and from another old Ngamini man called Pinmili, while Linda and Frank Crombie had learnt it long ago from old people at Pandie Pandie Station. Their story clearly belonged to the same tradition as the story of Marikilla written down by Reuther at the beginning of the century. There are however three major differences. In the first place, the Wangkangurru speakers evidently did not know those northern traditions that form the beginning of Reuther's version. Secondly, their recitation was much more lively than Reuther's version, and lastly, in contrast to Reuther's version it relates the story directly to the landscape.

Mick McLean and Linda Crombie at an interval of 18 years, told the same story almost verbatim. Both spoke in Wangkangurru, and direct speech was kept in Ngamini. In translation the Wangkangurru version is as follows:

Kurkari the Green Snake and a companion (who left him after a while) came from far away to the north, from near the Toko Range, where they had been initiated. *Kurkari* travelled south via Annandale and followed the Georgina down to Goyder's Lagoon. He went on to the area near Two Wells *Kuturunha.* This was the country of the Goanna people. The big Old Man Goanna was resting in *Wampirka katu* 'Goanna Shelter', also known as 'Slippery Swamp', while the main camp was by the small watercourse that comes in from Two Wells. *Kurkari* lay down to rest in a sheltered place with a few coolibah trees, a site which Mick McLean called *ThaRamani.* It is an unusual little grove, being right alongside a sandhill which Linda calls *Kuti-Kubmari* 'Swan Blood'. Two boys from the camp played around on this sandhill throwing boomerangs, picking them up again and then throwing them again. One of them threw his boomerang into the little grove and just hit *Kurkari's* nose as he lay there: green snakes still have a peculiar-looking snub nose. As the boys came to pick up their boomerang they saw *Kurkari* there with his strange face and huge long hair — said to be at least four metres long — holding their boomerang in his hand. Terrified, they ran away. He called out to them in Ngamini:

Kanku-kuli,	*kanku-kuli*	*nganji*	*karna!*
Boys-two,	boys-two	I	man!
Wata parnda-nu ngana!			
Not afraid-ERG be!			

'Eh you two boys, eh! I am a man! Don't be frightened of me!'

They ran and ran, and he came running after them, still calling out and still holding their boomerang. The boys didn't look back and when they got home they told everybody that a strange-looking creature had arrived, *nhuyu, nhuyu thutju!*

Kurkari slowed down, still following them. He came to the top of a sandhill, and looked down on the Goanna camp. In the evening the Goanna people had a big ceremony with beautiful girls dancing. *Kurkari* became infatuated with two of the girls. As he sat there on the sandhill he swallowed his spittle and his eyes went white (a standard description of extreme lust) as he watched them dancing. This was at Two Wells, *Kutjurunha. Kurkari* called out to the two girls in their language, Ngamini:

Nganji mankarra kapukapu ngalthimpara
I girl seeking bachelor
warritha-ngundu nganji nhuwa kapukapu
afar- from I wife seeking
wapa-rna warayi.
come-participle auxiliary.

'I have come from afar, as a bachelor seeking a wife!'

Nobody took any notice of him, so he called out to the two boys that he had seen before:

Kardi-mara-yi!
Brother in law-pair-emphatic!

'Eh, my two brothers in law!'

They answered:

Wibma ngalki-lha!
Corroboree dance-fut!

'We are having a corroboree!'

They were asking him to come and watch the corroboree. He answered:

Ah! nganji kuthari-yi!
Ah! I being tired-present

'I am too tired!'

Kuthari-yi nganji wap-rna warayi
Tired-present I come-participle auxiliary
mankarra kapukapu ngalthimpara
girls seeking bachelor.

'I am tired, I have come from afar, a bachelor looking for girls!'

Nobody else paid the slightest attention to him. They all went on with their ceremony. *Kurkari* knew the women would have to go down to a small waterhole to get water the next day, so overnight he started to dig a tunnel beneath the track leading there, and he lay hidden there. The next day people from the camp all came to get water. They came and went, they made many trips. He watched them and he watched the sun. The two girls he fancied were the last, they came on their final trip near sundown. He crawled out of the tunnel and as they came he grabbed them. He tied them up with his long hair and carried one on his head and one on his back. He put a spell on them to lull them to sleep, and carried them off to *Milkipatanha* Swamp (Lake Milkapurda).

The spell made the older girl go to sleep altogether: she died, leaving just *Kurkari* and the younger girl, but she too died at the Swamp, suffocated by his long hair. Before the two girls died *Kurkari* had a tremendous time. It was too much for him and he collapsed[1]. All three are still there as a set of rocks in the *Milkipatanha* swamp. According to Linda Crombie one large red rock, which represents the Erotic Green Snake, looks like a man lying down with one knee bent upwards. His long black hair is also visible as black soil among the rocks. Anyone suffering from baldness can go there and rub himself with some of the soil and it is said that he will grow luxurious hair like *Kurkari's*. The girls are there, in one version as rocks and in another as prickly *ngama-ngama* bushes. *Kurkari* ultimately revived. He left the swamp and ended up as a rock on the west bank of the Diamantina at *Makupulkini,* after he had 'lost all his front part' on account of his activities.

This myth was one of the most popular among the people on the eastern side of Lake Eyre. P. Austin recorded a brief outline of it from Leslie Russell, a Wangkangurru man who also spoke Diyari, in 1974. The songs that originally belonged to the myth have been lost, except for the five lines transcribed by Reuther in his version of the story. There was however, at the turn of the century, an old man at the Killalpaninna Mission who was in spirit transported to important places in the Lake Eyre Basin and was 'given' songs about them. He in turn passed the songs on to Leslie Russell and his brother Jimmy who sang them in the 1960s. One of the verses belongs to the Green Snake. It contains the Diyari word *kapirri* 'goanna' and the phrase *minha thutju* ('what serpent is this'), identical in Diyari and Ngamini, uttered by the terrified Ngamini Goanna-boys.

Kapĭrreré	Goannas (say)
Aminhánga·thutjúngera	What serpent is this?
Minhángera thutjúngera	What serpent is this?
Kapĭngere nginée	Goannas indeed
Minhángera thutjúngera	What serpent is this?
Kapĭngere rĭngerée	Goannas indeed
Minhángera thutjúngera	What serpent is this?
Kapirr . . .	Goanna . . .

Reuther's version of the myth and that told to L. Hercus by Wangkangurru people sixty years later corroborate and elucidate each other in many ways. For example, the alternative names given by Reuther to the Green Snake become meaningful in the context of the Wangkangurru story. 'Ngurapata', which means 'camp in wet sand' in both Wangkangurru and Ngamini, derives from the fact that *Kurkari* lay in an underground tunnel near the waterhole. The alternative name 'Ngaltimpara' also becomes clear. The ordinary common noun 'ngalthimpara', 'a young unmarried man in search of a bride' — which is what *Kurkari* says about himself over and over again — was evidently interpreted by Reuther as a proper name. This process is very common in the Reuther manuscript: many of his names for Ancestors are either nouns describing them or nicknames derived from what they say. The expression 'ngaji ngalthimpara', 'I am a bachelor', is the exclamation most associated with *Kurkari*. The Ancestor 'Ngaltimpara' is linked by Reuther with Lake Milkapurda.[2] There are even two toas (105 and 178) belonging to 'Ngaltimpara'. These toas lead us to places, 'Karlatjerkini' and 'Dakungarangaranni', both of which appear on Hillier's map a short distance north of 'Kutjuru', i.e. Two Wells. 'Dakungarangara' *(Daku-ngara-ngara,* 'sandhill heart'), 'the heart-shaped sandhill named by Ngaltimparana' is noted a short distance north-west of Karlatjerkini. Both are in the Two Wells area and confirm the location of the myth as told by Wangkangurru people.

Some of Reuther's comments in the place-names volume intermesh with the traditions recorded from Mick McLean and the Crombies. Thus Reuther's 'Judlajudlanja' tribe could immediately be identified once we learnt from Mick McLean that *Kurkari* came from near the Toko Range. This is the country of the northern group of Wangkamadla people, who, as shown by Breen (1971: 7) are referred to as Ulaolinja, Ulla-la-linya and Yoolalnanya by Roth (1897), Curr (1886–87), W. G. Field (1898) and R. H. Mathews (1898) respectively. Tindale (1974) calls them Julaolinja. 'Judlajudlanja' is a German spelling for the same name, with the prestopped *l* (i.e. the pronunciation *dl*) which a Wangkangurru or Diyari speaker would have used.

The mysterious comment by Reuther that the area from where the Green Snake came was 'the Province of the Kankuwalana' (Diyari *Kanku-wurla-nha,* 'the Two Boys') makes sense in the light of the Wangkangurru traditions recorded over the last few decades. The long myth of 'the Two Boys from Dalhousie' goes through Sandringham and Glenormiston. There are major Two Boys sites on Sandringham, and the main ritual centre was *Ithapuka,* Ethabucca Spring, about 60 km north-west of Sandringham.

The elucidation is not all one way. The story as told by Reuther has a much more elaborate beginning: it relates the myth of the Green Snake to Central Australian creation mythology and gives an added perspective of depth.

ii The story of 'Minalajerkina', the Ancestor who made bags

Reuther's place-name entry no. 1932 reads as follows:

> *Tirpakurli,* Ngam.
> *Tirpa* in D. = *kajiri* = 'creek, watercourse'; *kurli* in D. = *mandru* = 'two'. Meaning: 'two creeks'. Marumakapurini discovered two creeks here between the hills. He therefore named the place accordingly.

There is no mention of any major myth in connection with this place.

In Volume X there appears the story of the Ancestor 'Minalajerkina'. We are told (p. 57):

> Together with his wife he emerged out of the earth at a place called Narani (= to chase away). The place mentioned is situated on the Salt Creek near the present waterhole of Ngapabulu.

Further down the page we read 'he devoted himself to his main and favourite occupation, making *bilis* [bags].'

There is no obvious connection between the two entries, and on Reuther's evidence we would have little hope of finding the places mentioned. Tirpakurli is shown, but Narani does not seem to appear on the Hillier map. The name 'Ngapapulu' is given in a location just north of Jarpawarili, i.e. the Yelpawaralinna waterhole south-east of Clifton Hills, some considerable distance away.

Aboriginal traditions can however help us out of this dilemma. In 1969 the late Mick McLean took Graham and Luise Hercus to a double waterhole in Goyder's Lagoon. He named the place *Thirpa-kuli* and he showed us the ruins of the Old Lagoon Homestead close by. He took us to another channel, not far away to the east, to a waterhole which he called *Nharrani,* 'Seven Mile'. This was a place of special significance to him, because it was there that he had taken part in the big Mudlungga ceremony in 1901 (Hercus 1980). The descriptive detail given by Reuther is misleading: there are no hills anywhere in the vicinity. *Thurpa-kuli* is right in Goyder's Lagoon and there is only some slightly raised ground between the channels.

In 1987, long after Mick McLean's death, Frank and Linda Crombie directed Vlad Potezny, Luise Hercus and Philip Jones to the same sites, to *Thirpa-kuli* and to *Nharrani.* Linda is of part Yarluyandi descent and she knows the Yarluyandi Swan History. In this story and song-cycle the Swan Woman gave presents of flour and meat to a man

from *Thirpa-kuli*. He in turn gave her numerous bags that he had made. She did not realise that they contained lizards and poisonous snakes; she put them over her shoulder. The small child she was carrying peered into one of the bags and was immediately bitten by a snake. 'Why is my baby so quiet?' she asked herself after a while — only to find that the child was dead. She cursed the man from *Thirpa-kuli*. The Swan History fits in perfectly with Reuther's myth of 'Minnalajerkina', the Ancestor who made bags. Only Reuther's mention of the waterhole called 'Ngapa-pulu', near *Nharrani*, remained unexplained. It is tempting to suggest that Reuther learned the myth and got the place-names from eastern Wangkangurru people who used the translation *Ngapa-pula* 'two waters' for *Thirpa-kuli*.

The quality of Reuther's information in other volumes of his great work leaves no doubt that he was an exceedingly careful writer. He painstakingly recorded what he was told, knowing that much of the traditional knowledge he put down would soon disappear. If anything, he lacked imagination: he did not improvise. As shown previously in connection with *toas* (Hercus 1987), there are inconsistencies between the volumes rather than straight contradictions. The inconsistencies with regard to place-names and mythology are so great that they leave us with only one explanation. Reuther wrote with the kind of dedication and endurance that one would associate with someone who spends 18 years of his life in isolation from the outside world, in the heat and discomfort and often misery that was Killalpaninna, because he felt that this was his duty to God. He went painstakingly ahead. He presumably asked his old advisers — whom he never names (see Jones & Sutton 1986: 52) — and simply wrote down what they told him about one myth. When they finished he did not ask for explanations or implications nor for exact reference to places. He asked for another myth, and then another. He numbered the song verses and put them into a separate book in sequence. Though this book of verses is now lost, information obtained by L. Hercus from the late Mick McLean makes it clear that these verses were numbered in the sequence they were sung — a matter very important in Aboriginal recitation, and they were highly accurately transcribed, but with major omissions. Reuther 'ploughed through' the material he was given. This is how he wrote the volume on mythology. When he wrote the place-names volume he presumably asked for names in certain areas — the sequence makes it likely that he would get hold of different groups of people every evening for weeks and weeks and ask them about places in their area, and expect the answer to conform to the formula of his entry:

a. What was the meaning of a place-name? If it was not in Diyari, what would be the Diyari equivalent?
b. Why was it so called?
c. Who named it?

Aboriginal mythology is not an inventory of site-related facts, it does not explain every feature, it highlights important features. It creates a vision: this has been brilliantly described by T. G. H. Strehlow for Akár'Intjôta in Lower Southern Aranda country (Strehlow 1970: 134). In the same way, looking at the rocky hills near Mt Gason, traditional people with their mind's eye could see that these were the storm people from Coober Pedy arriving from the south. They could look across to Two Wells and see the hills that are the Goanna Girls, they could glance over to the sandhill near the old bore and see the weeping Swan Woman, lost, and carrying her dead baby. There was more than a vision, there was also music: as traditional people looked at the landscape they could hear the songs that belonged there. Back in 1900 those old men had been summoned with a 'cooee' and sat amid unfamiliar surroundings in the study of the meticulous Reuther. Even with all their nostalgia for their own sites they could not have conveyed to him any concept of the vision or the music. He must have gone on asking his three basic questions about place after place. Notwithstanding the fact that he was at Killalpaninna in the first place to stamp out the rituals belonging to the 'heathens', Reuther showed extraordinary esteem and understanding for Aboriginal traditions. Under the circumstances he could not possibly have been expected to discover which places were important for rituals; he could not have been expected to ask for instance whether *Pitikiri* (a waterhole on the Diamantina with a Ngamini name) was a major ritual centre where great ceremonies had been taking place. He simply asked what the name meant, and they told him. If one is making a vast inventory, such as he was, it is equally difficult to discern which things are relatively unimportant. A place need not have a special significance, it need not be connected with any Ancestor, in other words not every named location was a totemic site. Places could simply have names and even if a great Ancestor visited them the name need not have any relevance to him. Those old men were obviously asked about the many places that are not on the direct line of travel of any Ancestor, but were in the general area where such an Ancestor had been. To the question 'Who named it?', there was only one logical type of answer: 'It must have been the Goanna mob', or 'Miritirana's mob' and so forth. It was all detail; the highlighting, the vision and the music had gone, as had the lively humour of the mythology. It is important however, to remember that if it had not

been for Reuther's careful and accurate investigations much knowledge would have been entirely lost.

Practical Difficulties

The most obvious practical difficulty in finding places by means of the Hillier map is that with the exception of hills and lakes the names are written on the map, but no actual location point is given. We therefore cannot know what is being named, whether it is a waterhole, a small claypan, a sandhill, or a swamp. The list of place-names does not always help us here, and can in fact be misleading (Hercus 1987: 63). Sometimes a place-name is shown twice in an immediately adjacent location. In the case of 'Munkirra' for example, one listing represents the Moongara *(Munkira)* waterhole and another is the site of the Moongara swamp. This fact can only be learnt on the ground: there is nothing on the Hillier map to indicate which is what, or why indeed the name appears twice. Moreover, since there is no dot to show the precise point, we cannot know whether the place is to be found near the centre, near the beginning, or at the end of the written name. This makes quite a difference when one is dealing with a 1: 500 000 map; as R. S. Wilson has pointed out in his thesis (1981: 6), a name can be spread over 15 kilometres. It is therefore inevitable that a small site or a buried *mikiri* well in the Simpson Desert would be nearly impossible to find by means of the data on the map.

The second problem is that in the area which was known best to Reuther and Hillier, namely the Lower Cooper and to a lesser extent the Diamantina, the writing is so crowded that the exact location of a place becomes most uncertain, although it is precisely in those areas that the map is reasonably accurate. The further one goes into desert country and the further one goes from Killalpaninna the more inaccurate the locations. The Simpson Desert was largely unexplored by Europeans at the beginning of the century and it is not surprising that Hillier simply gave up here. He has written in a long column of names which are not in any geographical sequence. Recent work in the Simpson Desert makes this clear (Hercus & Clark 1987). Even those names which are not in the big column appear to be random in this area; for instance *Kadlalumba,* 'Karlalumba', which is the northernmost well in South Australia, is shown about 150 km south-west of its correct location. Some places are given twice, both in the column and in the more dispersed listing: 'Jadalnga' and 'Jatalnga' *(Yatalknga,* the Goanna totemic centre of the western Simpson Desert). It would have been physically impossible to put these names accurately on a map where even the big salt-lakes were as yet not marked. The lower Macumba, the Kallakoopah and the lower Diamantina were also not well known to surveyors. For these reasons it is not surprising that the great Fish and Crane totemic centre at *Payanta,* 'Pajanta', appears on the Kallakoopah instead of the Diamantina, and *Pultjara,* 'Buldjala', is written some 60 km east of where it should be. Sometimes, though rarely, in Aboriginal traditions two places have the same name, but this could hardly be an explanation for all these highly inaccurate locations. The inaccuracy was inevitable because of the state of non-Aboriginal geographical knowledge at the turn of the century.

The far south-western corner of the Hillier map, where more geographical features were known to Europeans at the time, was a considerable distance from Killalpaninna. Not even the creeks are marked here and we would have no hope of finding any of the places if, for instance, we did not know from the late Mick McLean, Arthur McLean and Brian Marks that *Warliyara,* 'Warlijera' was the Stuart Creek Station waterhole, that *Paparla* 'Head' was a waterhole immediately to the south-west and that *Thidnapirri,* 'Tidnapiri' ('Toenail') shown as some 10 to 15 km away to the north-east was a small waterhole close by; the body parts refer to the story of the Dead Woman from Stuart Creek. We could guess that 'Walkararana', 'She is sorry', refers to the Walcarina Spring, but nothing other than the surviving traditions could tell us that *Urkardu-kardi-parraparra* 'Ulatukadiparapara' ('Long fruit of the wild melon creeper') was the name of Pound Creek, nor that 'Kudnangamba', 'Guts', was a spring by the North Creek near Curdimurka (Hercus 1976).

In order to demonstrate the difficulties of the Hillier map we will take just a small area which was reasonably well known by Europeans at the turn of the century, namely Andrewilla, south of Birdsville on the Diamantina River. We have compiled a map of sites in this area (Fig. 2) on the information available to us up to date in order to compare it with the Hillier map (Fig. 1). Our information comes from Linda Crombie and the late Frank Crombie who have spent their lives in this country and know it intimately. It was in this general location that the Hillier map was particularly perplexing.

It has been assumed that Hillier based his map on an existing pastoral map, as these were the earliest maps produced of the far north of South Australia to show the distribution of pastoral leases. For this reason a slightly more recent pastoral map of the same scale was shown as the base of a comparative map to show the location of sites documented by Hercus and Potezny. Prominent hills or high spots (indicated by small triangles on

both maps) are in near identical positions on both maps. Prominent hills were accurately located by explorers and surveyors from the earliest days of European colonisation. The most conspicuous difference between the two maps is the outline of drainage indicated on the Hillier map.

The Lower Diamantina in South Australia consists of a main channel with numerous minor channels in a very broad floodplain. The main channel eventually divides before emptying into Goyder's Lagoon, an extensive lignum swamp. Further to the west the channels of what is locally called the 'Georgina' (the lower Mulligan River of the maps) empty into the same floodplain. Access to sites within the floodplain has over recent years been difficult with unseasonal rains and subsequent high water levels. Then, in the dry, access has also been hampered by extensive 'crabhole' country and deeply scoured channels. At the turn of the century travel by Europeans in this area would have been a daunting task indeed. Journeys that now take days would have taken many months with attendant logistical problems. We can therefore take it for granted that neither Hillier nor Reuther could have had the time or means to visit the majority of places around Andrewilla that are listed on the Hillier map.

The Crombies pointed out and named numerous places from a distance. On account of their uncertain location, these places have not been included on our map. In order to establish a solid basis for comparison only sites whose position is accurately known are listed. Because of difficulties of access the only portion of the Diamantina that has been mapped in any great detail is the western side of the main channel for some 15 km south from the junction of the Andrewilla channel. This has produced virtually a name for each bend of the river, and most of the prominent dunes and waterholes on minor channels. From information on sites which have not had their exact locations verified, it appears that a corresponding density of placenames will occur for the remainder of the floodplain. This would correspond to the density of sites listed on the Hillier map.

Practical considerations lead us to think that there were four categories of sites on the Hillier map:

1. Places within reasonable reach of Killalpaninna Mission, along the old Kalamurina track and the southern portion of the Birdsville Track which Reuther and/or Hillier are likely to have been able to visit personally.
2. Places with Aboriginal names that were shown on the pastoral map: these are mainly the prominent features mentioned above, such as hills and lakes as well as some very conspicuous waterholes such as 'Tipaminka' and 'Kandiritja'.
3. Places for which Aboriginal people were able to supply series of names in lines of travel or following watercourses in areas where European geographical knowledge was adequate for reasonably accurate positioning on maps.
4. Places for which Aboriginal people were — as always — able to supply series of names in sequence, but where European knowledge was so inadequate that the names simply appear as lists or are just put in a general location.

Sites of the categories 2 and 4 are to be found in the section of the Hillier map centred on the Andrewilla region.

On Hillier's map the Georgina channels look as if they had no sites on them. There are, however, four columns of names running parallel to the floodplain of the Diamantina. The westernmost column contains near the top some sites that are on the Diamantina channel, such as the *Ngapangandaka* waterhole. *Kanti-purru,* 'Kandiburu' ('Waddy having') is the name of a sandhill which (with some interruptions) reaches from a few kilometres east of the Georgina to the Eleanor channel of the Diamantina; the Black Snake ancestor travelled along this sandhill carrying a waddy. All the sites listed below 'Kandiburu' belong not to the Diamantina, but to the various Georgina channels. Linda Crombie recognised every single name in the column and said 'That is all Georgina country'. The few names that do appear on modern maps confirm her view. The people who gave the original information obviously imagined themselves travelling along the Georgina and named the places accordingly. The list includes different channels: 'Kudnuku' for instance is a waterhole on a separate outlying western channel of the Georgina and is the Koonakoo waterhole on modern maps, while 'Karatji', the Karachie waterhole of modern maps, is on an outlying eastern channel. This westernmost list includes the major Aboriginal habitation sites for the Georgina west and south of the *Kanti-purru* sandhill. It is absolutely Aboriginal-oriented and does not include the waterhole at Old Alton Downs on the Georgina which had the rather common name *Dikirri*, 'Canegrass'; another *Dikirri*, the one on the western branch of the Diamantina, appears roughly in its right location. Similarly the second column which contains names of places on the Eleanor channel of the Diamantina does not mention the large Karathunka waterhole. Karathunka was well known to Europeans and had been the site of a police camp since the mid-1880s. It seems almost as if, in the case of Old Alton Downs, Aboriginal people had purposely ignored European habitations. The location of the Georgina sites in a column, away from the channels where they should be, clearly indicates that these were sites of the fourth category: European geographical

knowledge was as yet inadequate for their accurate location.

The main Diamantina channel looks as if it had no sites on it, though some of the names in the third column belong to it. The situation with all the Diamantina sites is perplexing. Some of the sites are in the position where we would expect to find them. These are largely sites of category no. 2, which correspond to prominent features, like Lake Etamunbanie (Hillier's 'Jidalimanpa'). Other sites are in the position relative to each other where we would expect to find them, but not in a geographically accurate position. Examples are:

Ngapa-manha, 'Bad Water', the Appamurna waterhole of modern maps. Located on the edge of Lake Etamunbanie, this was the site of the old Minnie Downs station (Jones in prep.). On the Hillier map it appears far to the south of its location as does the nearby *Kuniwardunha*, Kuniwatatana sandhill. They are exactly where we would expect to find them in position relative to each other.

Thadna-pulu-thintjini, 'Tanabulutindi', and *Yabmalkira*, 'Jamakirra' (the Old Clifton Hills Station). These sites are shown at about the right distance and direction from each other in the second and third column, but far to the south of their true location.

A number of other sites are a long way from where we would expect them. This applies for instance to *Thirithayinha*, Tiritjina ('Dog-swallowing' waterhole — a reference to an incident in the story of the Rainbow Snake) which, according to the evidence of the Crombies, is in fact close to Pandie Pandie, and immediately south of *Paya-wutju*, 'Pajawutu' ('Blind Bird'), though not as yet mapped by us. *Ngantji-karini* is even further misplaced far to the east of Goyder's Lagoon, though there is of course always a chance that it may refer to another site of the same name.

All these are examples of sites of category 4, where both the Aboriginal informants and Hillier made a valiant effort to position the sites, but European geographical knowledge was simply not detailed and accurate enough. This can take nothing away from the fact that the map remains a unique and brilliant piece of work; Hillier and Reuther have come close to achieving the near impossible of showing so many sites in such near-accurate general locations despite the impossibility of visiting them. We must be reconciled however to the situation that without additional information from archival sources or from knowledgeable Aboriginal people the map can not be used to locate otherwise unknown Aboriginal sites on the ground.

Notes on Orthography

In this paper a practical orthography has been used for Aboriginal words as recorded, and written in italics.

Plosive consonants other than the retroflex plosive have been written as unvoiced *(k, p, th, t)*, but prestopped consonants have been written with voiced plosives as this corresponds most closely with the pronunciation, hence *bm, dn, dnh, dnj, dl, dlh.*

Retroflexes have been written as *r* + consonant, hence: *rl* is retroflex *l*, *rn* is retroflex *n*, *rd* is retroflex *t*.

Interdentals have been written as consonant + *h*, hence *nh, th, lh.*

Palatals have been written as consonant + *j*, hence *tj, nj, lj,* and *ng* has been used for velar *n*.

The three r-sounds have been transcribed as follows: *r* = the alveolar flap, *rr* = the trilled r, *R* = retroflex r.

Acknowledgment

We are indebted to P. Austin for his advice and for correcting the translation of the Ngamini sentences.

Endnotes

1. The old men apparently did not like telling Reuther about this, and he says in his version (Volume X: 122) 'Why Marikilla died the legend does not say'.

2. Reuther (Volume VII: 1001) says that the name 'Milkipata' is Wangkangurru and that it comes from *milki* 'eye' and *pata* 'clay, dirt', and says also that it was the name both of the place and of an Ancestor, who smeared the clay on his face in order to approach some waterbirds to within throwing distance. 'When *Ngaltimpara* met up here with Milkipata, he said to him: *Pirnarulai jidni milkipata* "Oh venerable old man, your eyes are still dirty". That gave rise to the naming of this place.' The words *milki* 'eye' and *pata* 'wet soil' are shared by Ngamini and Wangkangurru. The place is certainly not in Wangkangurru country, and the Ancestor was talking in Ngamini.

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THE SOUTH AUSTRALIAN MUSEUM'S NITRATE NEGATIVE COPYING PROJECT

The photographic collections of the South Australian Museum's Anthropology Archive have accumulated over the course of a century. As well as documenting the activities of staff on various expeditions, these collections reflect the diversity of the Museum's anthropology collections in two main regions, the islands of the western Pacific and within Australia itself. The Australian photographic collections are by far the largest component of the Archive: over 60,000 of the approximately 70,000 images dating mainly from the 1880s are from this country.

Since being assembled as a single archival collection during the 1970s, the photographs have been subject to two main organisational and cataloguing operations. The first occurred during 1979–80, when an archivist was employed to organise the Anthropology Archives according to professional archival principles. This project resulted in the successful cataloguing of the bulk of all archival manuscripts, sound tape, cine film, works on paper, and photographs received up until that time. A series of 'AA' (Anthropology Archive) numbers was applied to the individual collections, and material was catalogued and shelved according to this numbering system. Filing cabinets were used to store the extensive collections of loose prints and negatives, comprising original material and copies. A programme to generate copy negatives and prints from the large series of glass negatives was largely completed during the decade following the initial project.

A second phase of organisation began during 1989 and will continue at least until the mid-1990s. This involves the separation of negatives from prints in a new storage system of archivally-sound photograph albums, developed in consultation with the State Conservation Centre. The accessibility of the photographic collection to researchers and staff has already been tremendously improved through this project. It has also enabled much greater opportunities for evaluating the present conservation status of the collection and its individual parts.

It was while undertaking this second phase that an extremely large proportion of cellulose-nitrate based negatives was identified, dispersed throughout the photographic collection. Advice from the State Conservation Centre confirmed that these negatives would eventually degrade, threatening the rest of the collection with toxic fumes and posing the threat of possible self-ignition. As overseas examples have shown, a fire involving nitrate stock can be potentially disastrous, as the burning material generates its own oxygen and cannot be extinguished by conventional means.

The necessity for immediate action to deal with this dilemma was apparent. The Museum Board provided funds in the first instance, to employ a person to isolate all nitrate negatives from the archive collections and to interleave the individual negatives with acid-free tissue paper. This was successfully achieved with a number of smaller collections totalling some 12,000 images, while a separate single collection (the W.D. Walker collection) comprising about 8,000 nitrate images was carefully inspected.

Given the potential state of degradation of nitrate negatives, the collections were found to be still in extremely good condition, with very few exceptions. Of the possible seven or eight stages of decomposition, the great majority have reached only the stage of discolouration or silvering on the emulsion surface. Nevertheless, bearing in mind that the decomposition process can accelerate and is still unpredictable, it was decided to apply to the Federal Department of Aboriginal Affairs (now reconstituted as the Aboriginal and Torres Strait Islander Commission) for a grant to enable the most significant images to be copied onto safety film. We were extremely fortunate in being awarded a grant of $20,000 from the Department in April 1989. An equivalent sum was also awarded by the Department for the Museum's programme of consultations about secret-sacred material with Central Australian Aboriginal communities.

With this grant the Museum was able to employ a qualified photographer, Scott Bradley, for six months on the project. Scott worked under the direction of the Museum's photographer, Trevor Peters, who had undertaken research on the problem and had devised the most effective and cost-efficient method of transferring the images. This involved re-photographing the negatives onto Agfa safety-base film, archivally processed to American National Standards Institute specifications (ANSI) to produce positive 2.25 sq. inch transparencies. These were then cut into strips of three and stored within polypropylene sleeves in custom-made albums, for eventual vertical storage in filing cabinets. Once these copied images have been catalogued and incorporated within the Anthropology Archives, they will be available for staff and external use.

The copying project has been a major success. The initial estimate of about 50 processed images per day was exceeded by 50%, and a final total of almost 10,000 images has been copied. This has left a balance of a similar number requiring the same treatment, but we are optimistic about obtaining the necessary support for this, following the success of the initial project.

A variety of photographers and their collections have been represented in the work so far completed. Examples include:

— George Aiston Collection. Photographs from the Birdsville Track region, taken during the 1920s and 1930s, depicting traditional Aboriginal activities as well as themes of station life, transport and the landscape.

— Cecil Hackett Collection. Hackett mastered the use of the pocket Kodak and his 1920s and 1930s photographs document several anthropological expeditions to Central and Western Australia.

— Aborigines' Friends' Association. This collection includes the photographs taken by Ernest Kramer, a non-denominational evangelist who travelled into the heart of Pintupi and Loritja country to the north-west of Alice Springs during the 1920s and 1930s.

— Edgar Waite Collection. Waite was Director of the South Australian Museum from 1914–29. His photographs cover a series of Museum expeditions during the period, including the 1916 expedition by camel to the north-east of South Australia.

— Norman B. Tindale Collection. Part of a larger collection, these nitrate negatives were produced by Tindale during the course of several Central Australian expeditions.

— Rex Battarbee Collection. This recently acquired collection includes some beautifully composed images of Central Australian landscapes and much important documentation of the Hermannsburg Mission.

— William D. Walker Collection. This huge collection of over 8,000 images contains a large component documenting Walker's 1927–28 journey through Central Australia, travelling in his T-Model Ford. The collection is supplemented by his own and his wife's detailed diaries.

Until quite recently it has been accepted practice for archives to destroy their original nitrate negatives once the images have been safely transferred to copies. Research indicates that if a collection of nitrate stock is in a stable condition, and is undisturbed by variations in temperature or humidity, it may well last satisfactorily for many more years. In the case of the South Australian Museum's collection, which still appears to be in excellent condition despite it dating to more than fifty years ago, there is every reason to attempt to preserve it in the same state. A positive image obtained from the original negative will always be superior in every way to that obtained from a second-generation copy. The intention, therefore, is to store the nitrate collection in a secure, off-site location with controlled conditions of temperature and humidity.

The importance of preserving this unique series of photographic collections in its original form will be apparent to a large public audience in 1991. A selection of images from five of the nitrate collections – photographs by S. A. White, G. Aiston, W. D. Walker, E. Kramer and R. Battarbee – will be included in a major photographic exhibition at the South Australian Museum, titled 'Images of the Interior'.

P. G. JONES, South Australian Museum, North Terrace, Adelaide, South Australia 5000. *Rec. S. Aust. Mus.* **24**(2): 153–154, 1990.

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MUSEUM OF VICTORIA

REVISION OF THE AUSTRALIAN GENERA *EODELENA* HOGG AND *ZACHRIA* L. KOCH (HETEROPODIDAE: ARANEAE)

D. B. HIRST

HIRST, D. B. 1991. Revision of the Australian genera *Eodelena* Hogg and *Zachria* L. Koch (Heteropodidae: Araneae). *Rec. S. Aust. Mus.* 25(1): 1-17.

The Australian genera *Zachria* L. Koch and *Eodelena* Hogg are revised. *Zachria* is here limited to include only the type species, *Z. flavicoma* L. Koch and *Z. oblonga* L. Koch. *Z. magnifica* (Hogg) is removed to *Typostola* Simon, in which genus it was originally described. *Eodelena* is revalidated and removed from *Zachria*. *E. spenceri* Hogg, type species, and *E. melanochelis* (Strand) are redescribed. Five new species, *E. convexa, E. lapidicola,* both from Western Australia, *E. kosciuskoensis* from New South Wales, *E. loftiensis* from South Australia and *E. tasmaniensis* from Tasmania are described. *E. nigrifrons* Simon is transferred to *Delena* Walckenaer.

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This paper is the fifth of a revision of the Australian Heteropodidae, excluding *Heteropoda* Latreille, 1804. As with other Australian genera of the Heteropodidae, *Zachria* and *Eodelena* are poorly defined, consequently confusion of the taxa has arisen. *Eodelena* is further often confused with the genus *Delena*.

L. Koch (1875) described a new genus, *Zachria* for the species *Z. flavicoma, Z. oblonga* and *Z. haemorrhoidalis*. Hogg (1902) synonymised the latter with *Z. oblonga*. In the same work Hogg described the new genus and species *Eodelena spenceri*. Simon (1903) placed that genus in synonymy with *Zachria* on the basis of similar male palp structure. Later, Simon (1908) appeared to reconsider its position when describing *E. nigrifrons*. Bonnet (1959) remarked on this change but left the genus in synonymy with *Zachria*. Strand (1913) described *Z. melanochelis* while Hickman (1967) commented on the description and habits of *E. spenceri* under *Zachria spenceri*.

Materials and Methods

Larger body and leg measurements of types in poor condition are given to the nearest 0.1 mm. Leg ratios exclude coxa and trochanter. Redescriptions of type material give the present colouration of the specimen or, in the absence of any specimens, a condensed translation of the author's description is given. Female vulva is occasionally inspected without removal of the genitalia by dissecting and lifting on one side and brushing away fatty tissue. Other materials and methods are given in Hirst (1989a, 1989b, 1990). Types of newly described species are deposited in the Australian Museum, Sydney (AM), the Museum of Victoria, Melbourne (NMV), the South Australian Museum, Adelaide (SAMA), the Tasmanian Museum and Art Gallery, Hobart (TM) and the Western Australian Museum, Perth (WAM). Other acronyms are BMNH, British Museum (Natural History), London; QM, Queensland Museum, Brisbane, and ZMH, Zoologisches Museum, Hamburg.

Genus *Zachria* L. Koch

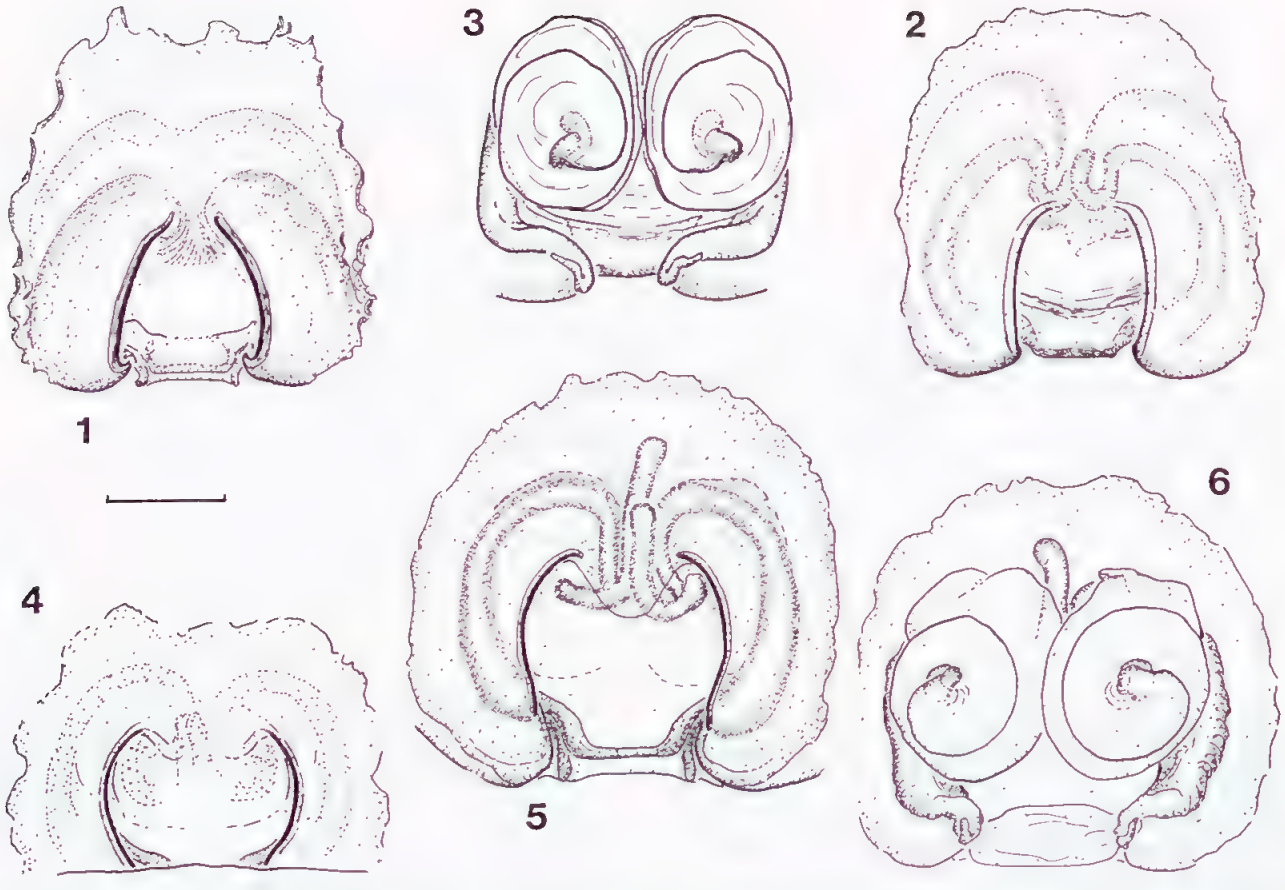
Zachria L. Koch, 1875: 649.

Diagnosis

Carapace longer than wide, low gently rounded sides, flattish medially. Anterior eyes subequal, AME closer to ALE than to each other. Sternum longer than wide, widest mid-length. Anterior legs three to three and a half times carapace length. All metatarsi subequal in length to tibiae. Female spermathecal sacs tubular, long, looped to anterior. Male [known only from L. Koch (1876), see later] with large palpal tibial apophysis and embolus coiled one turn alongside similarly coiled broad conductor in distal half of cymbium.

Description

Large spiders. Carapace longer than wide in the ratio 17:14; raised at sides, flattish above; low, about four and a half to five times longer than high, highest in region of fovea. Fovea a discernible shallow groove; surrounding area not depressed. Setae short. AME equal or subequal to ALE; distance between AME greater than between AME-ALE; posterior row slightly recurved. Chelicerae with two promarginal teeth; four retromarginal teeth, subdistal tooth largest. Labium wider than long in the ratio 7:6. Sternum longer than wide in the ratio 3:2. Legs relatively short, anterior pairs less than three to less than three and a half times



FIGURES 1-6. *Zachria* females. Figs 1-3, *Z. flavicoma:* 1, holotype epigynum; 2, epigynum and vulva of WAM 28/665, ventral; 3, vulva of WAM 28/665, dorsal. Figs 4-6, *Z. oblonga:* 4, holotype epigynum; 5, epigynum and vulva of NMV K-0956, ventral; 6, vulva of NMV K-0956, dorsal. Scale line 0.5 mm.

FIGURE 7. Distribution of *Zachria* and *Eodelena.*
Z. flavicoma □ , *Z. oblonga* ■ , *E. spenceri* ● , *E. melanochelis* ▼ , *E. tasmaniensis* ○ , *E. kosciuskoensis* ▽ , *E. loftiensis* ◇ , *E. convexa* ◆ , *E. lapidicola* △ .

length of carapace [leg measurements of the male *Z. oblonga* derived from L. Koch (1876) indicate a length of less than four times carapace length which is low for an Australian male heteropodid]; leg I, when outstretched alongside leg II, reaches to or near tarsi II. Abdomen much longer than wide, rounded, without pattern, or with dark median streak. Female epigynum with sclerotized lateral rim; fossa deeply recessed anteriorly, whitish, posteriorly with raised pigmented ridge. Spermathecal sacs tubular, long, curved to anterior and reaching to or beyond anterior of fossa.

Type species

Zachria flavicoma L. Koch, 1875 by original designation.

Remarks

Zachria differs from other genera of the Australasian subfamily Deleninae in having all metatarsi subequal in length to the tibiae. In the other genera it is more usual for either the anterior metatarsi or the fourth metatarsi, or both, to be longer than the relevant tibiae. Additionally, the significantly longer than wide carapace separates it from other genera except some *Neosparassus*. *Zachria* further differs from *Eodelena* in having the anterior eyes subequal with AME closer to ALE than to each other and in the presence of spermathecal sacs in the female vulva.

Zachria flavicoma L. Koch
(Figs 1, 2, 3, 7)

Zachria flavicoma L. Koch, 1875: 650, pl. 52, fig. 3. Holotype ♀, King George Sound, Western Australia, Bradley Collection. AM KS18911, ♀, King George Sound, [35°03′S, 117°58′E, Western Australia], agrees with the holotype in dimensions and accompanying data and is considered to be that specimen. It is believed to be part of the Bradley collection which found its way to the Macleay Museum of the University of Sydney, and is presently in the Australian Museum collection.

Diagnosis

(Male unknown). Female anterior leg ratio less than 3. Epigynum somewhat parallel-sided or narrower anteriorly. Vulva with anteriorly curved spermathecal sacs partly extending in front of fossa.

Female AM KS18911

CL 8.62, CW 6.95. AL 18.00, AW 9.90.

Colour in alcohol: Carapace yellowish-brown, striae darker, fovea reddish, caput dark reddish in ocular area. Setae brown. Chelicerae dark reddish. Maxillae and labium dark orange-red. Sternum orange-yellow. Legs dark yellow-brown, anterior metatarsi and tarsi dark orange-brown, patches of dark orange-brown on tibiae, metatarsi and tarsi. Area around sockets of heavier setae on venter and prolateral of femora dark coloured, giving spotted appearance. Abdomen creamy-yellow without pattern.

Carapace: Sides rounded, flattish medially, 5 times longer than high, lowest in ocular region, relatively level from posterior of eyes to posterior of fovea. Eyes: AME 0.52. AME: ALE: PME: PLE = 1: 1.04: 0.54: 0.73. Interspaces: AME-AME 0.58, AME-ALE 0.38, PME-PME 1.69, PME-PLE 1.65, AME-PME 0.96, ALE-PLE 1.23. MOQ, aw: pw: 1 = 2.50: 2.77: 2.31. Width of clypeus to AME 0.29. Labium: L 1.22, W 1.42. Sternum: L 4.38, W 2.90. Legs: anterior leg ratios I = 2.7, II = 2.9.

Epigynum: (Fig. 1). Lateral rims of fossa somewhat parallel; anterior of fossa recessed. Vulva of WAM 28/665 (Figs 2, 3) with spermathecal sacs moderately long and arced at anterior edge of fossa.

Variation

Carapace length of WAM 28/665 is 8.75.

Distribution and remarks

(Fig. 7). *Z. flavicoma* occurs in south-west Western Australia. The male is unknown. The female differs from *Z. oblonga* in the relatively shorter legs, the absence of markings on the abdomen, shorter spermathecal sacs and the insemination ducts with slightly reduced coiling.

Other material examined

Western Australia: Juv., Binnu, 28°02′S, 114°40′E, July 1965, M. deGraaf, WAM 88/1498; ♀, Mundaring, 31°54′S, 116°10′E, 3. vii. 1928, E. Riley, WAM 28/665.

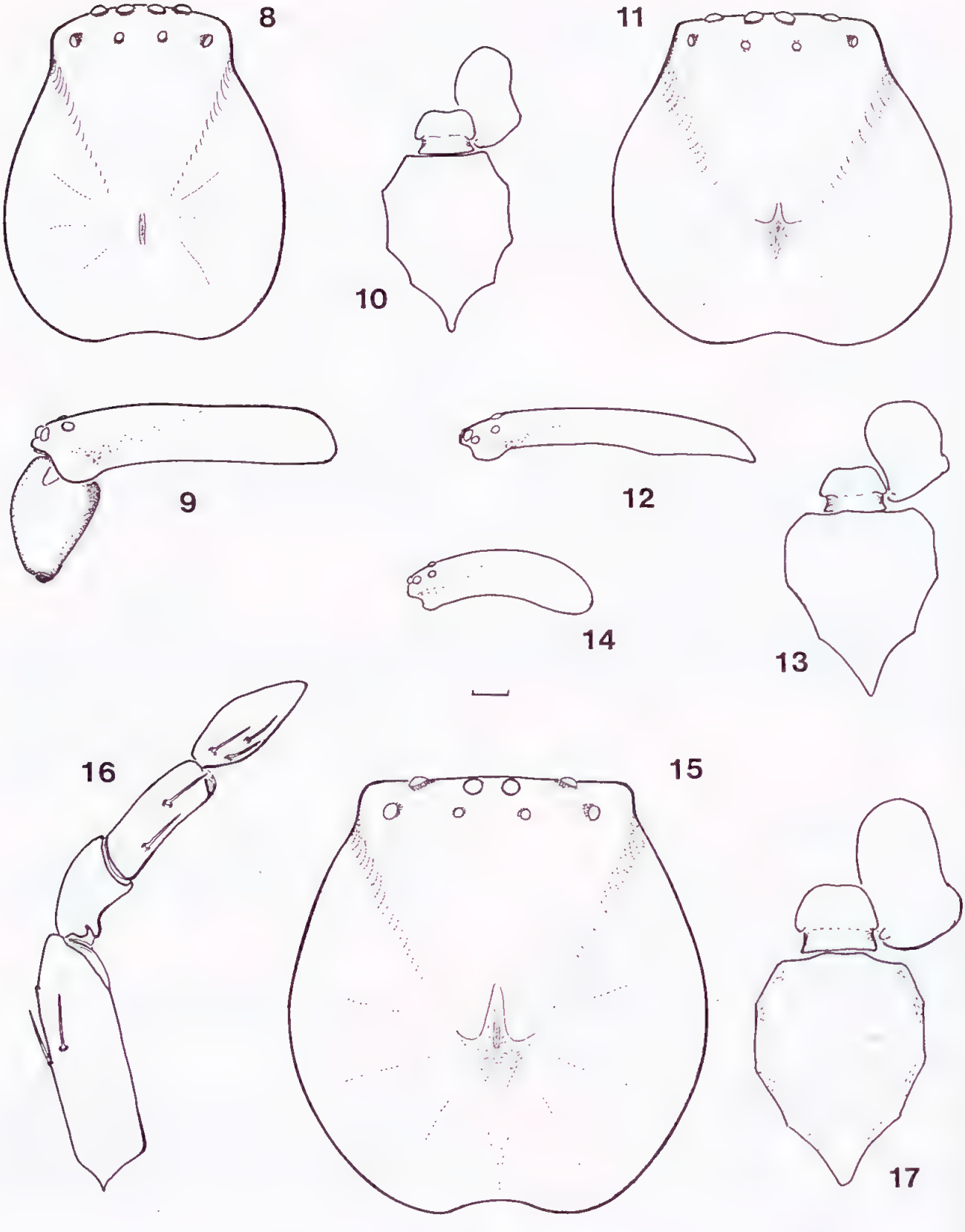
Zachria oblonga L. Koch
(Figs 4, 5, 6, 7, 8, 9, 10)

Zachria oblonga L. Koch, 1875: 651, pl. 52, fig. 4. Holotype ♀, Sydney, New South Wales, ZMH (Mus. Godeffroy Nr 11022), examined. A second ♀ in NMV (K-0955), [where a small part of the Godeffroy coll. is housed] not mentioned in Koch (1875), also has the number 11022 but is without further data.

Zachria haemorrhoidalis L. Koch, 1875: 653, pl. 52, fig. 5. Hogg, 1902: 454. Syntypes, 2 juveniles, Sydney, New South Wales, ZMH (Mus. Godeffroy Nr 11021), not examined.

Diagnosis

Abdomen may have a dark narrow stripe dorsally. Female anterior leg ratios between 3 and 3.5. Fossa



FIGURES 8–17. *Zachria* and *Eodelena;* carapace, sternum, maxillae, labium and palp. Figs 8–10, *Z. oblonga,* NMV K-0956: 8, carapace, dorsal; 9, carapace and chelicera, lateral; 10, sternum, labium and left maxilla. Figs 11–13, *E. spenceri:* 11, carapace, dorsal; 12, carapace, lateral; 13, sternum, labium and left maxilla. Fig. 14, *E. convexa,* carapace, lateral. Figs 15–17, *E. lapidicola:* 15, carapace; 16, left palp of holotype male, prolateral; 17, sternum, labium and left maxilla. Scale line 1mm.

broad, rounded anteriorly; spermathecal sacs long, extending well to anterior of fossa; insemination ducts coiled 1½ times.

Holotype female

CL 9.75, CW 8.40. AL 15.50, AW 8.70.

Colour in alcohol: Carapace yellow-orange, caput reddish. Chelicerae dark red-brown to blackish. Maxillae and labium reddish. Sternum yellowish. Legs yellow-brown, metatarsi and tarsi reddish. Abdomen dark yellowish dorsally; venter yellow.

Carapace: gently rounded sides, somewhat flattish medially, 4½ times longer than high. Eyes: AME 0.50. AME: ALE: PME: PLE = 1: 1.2: 0.7: 0.8. Interspaces AME-AME 0.8, AME-ALE 0.6, PME-PME 1.8, PME-PLE 2.0, AME-PME 1, ALE-PLE 1.4. MOQ, aw: pw: 1 = 2.8: 3.2: 2.8. Width of clypeus to AME 0.6. Sternum: L 4.74, W 3.07. Legs: anterior leg ratios I = 3.1, II = 3.5.

Epigynum: (Fig. 4). With broad thinly sclerotized lateral sides. Fossa whitish allowing the long tubular spermathecal sacs to be seen beneath. Vulva of NMV K-0956 (Figs 5, 6) with insemination ducts coiled 1½ times.

Description of male modified from L. Koch (1876)

CL 8.0, CW 6.5. AL 9.0 AW *ca* 6.0 (not as broad as carapace).

Colour in alcohol: Carapace brown-yellow, ocular area with black-brown patches; adpressed setae yellow, upright setae black. Chelicerae black-brown; setae grey-yellow; black bristles. Maxillae and labium pale reddish-brown. Sternum pale yellow; setae concolourous. Abdomen dorsally with yellow setae, deep blackish narrowing long stripe, anteriorly indistinct, posteriorly blackish and reaching to spinnerets; venter pale yellow with white setae forming stripes. Spinnerets brown-yellow; black setae. Palps brown-yellow, cymbium black-brown with grey-yellow setae. Leg femora brownish-yellow, remaining segments (patellae to tarsi) light reddish-brown; adpressed setae yellow, upright long setae black; scopula blackish-grey.

Carapace: 0.15 mm longer than broad, low, dorsally flat; fovea shallow, long but not reaching posterior declivity. Eyes: both eye rows straight; AME almost their diameter apart, AME-ALE also almost width of AME apart, ALE as large as AME. Legs: Anterior leg ratios *(ca)* I = 3.5, II = 3.7.

Palps: From the illustration given by L. Koch (pl. 73, fig. 3) the embolus appears to be narrow and coiled once distally while the conductor is thick and also coiled once distally. The palp resembles that of *Eodelena* but the embolus and conductor extend further proximally in the alveolus of the cymbium and the tibial apophysis appears larger and more robust.

Variation

Carapace length of females 8.12–9.15, mean 8.52 (n=4). While most specimens examined are without pattern (partly due to age as the holotype is without a median stripe, though this was clearly figured by L. Koch, 1875) the abdomen of one specimen is with a brown longitudinal median streak which is darker in the posterior half.

Distribution and remarks

(Fig. 7). Known only from Sydney, New South Wales. Females are separated from *Z. flavicoma* by the relatively longer legs, the usual presence of a dark dorsal stripe on the abdomen, fossa broader, more rounded anteriorly, longer spermathecal sacs and insemination ducts with slightly greater coiling.

L. Koch (1876, p. 850; pl. 73, fig. 3) described and figured a male collected by Daemels from *Xanthorrhoea* (grass-tree), Sydney. The institution in which it was deposited was not given nor are its whereabouts known. It is not a type. A redescription modified from L. Koch is given above.

Other material examined

New South Wales: ♀, Scouts Gully, Gordon, Sydney, 19. xii. 1948, A. Musgrave, AM KS16609; ♀, Sydney, AM KS20788; ♀, 1891, W. K., NMV K-0956.

Species Transferred

Järvi (1912) transferred *Typostola magnifica* Hogg (1902) to *Zachria* on the similarity of the female vulva. That combination is not supported by the following characters: the carapace of *T. magnifica* is higher, ALE are larger than the AME and legs are relatively longer with some metatarsi longer than the relevant tibiae. Here *Z. magnifica* is transferred back to *Typostola* Simon.

Genus ***Eodelena*** Hogg

Eodelena Hogg, 1902: 464. Simon, 1908: 435.
Zachria: Simon, 1903: 1024. Bonnet, 1959: 4907.

Diagnosis

Low flattish to slightly raised convex carapace, usually wider than long, occasionally longer than wide. AME largest, closer to each other than to ALE. Anterior legs about four to five times carapace length. Male embolus with tip barely coiled once. Female epigynum small, weakly sclerotized. Spermathecal sacs absent.

Description

Medium to large spiders; low flat carapace with shallow, often indistinct fovea in circular depression or with slightly convex carapace and fovea a long

shallow groove. Anterior eye row straight, posterior row straight to slightly procurved; AME largest, PME smallest, laterals subequal. Clypeus half width of AME or less. Chelicerae with two promarginal teeth; three or four, rarely five, retromarginal teeth, proximal tooth small, others subequal, subdistal tooth usually larger. Labium 1½ times wider than long. Sternum truncate anteriorly, bluntly pointed posteriorly; widest between coxae II at ⅓ its length from anterior and barely longer than wide in the ratio 5:4, except *E. lapidicola* in which it is longer than wide and widest mid-length. Legs 2143. Leg I, when outstretched alongside leg II, reaches midway along metatarsus II. Dorsal tibial spines usually lacking, patellae usually without spines except retrolaterally on II. Tibiae ventrally with three spine pairs except IV which often has two, lacking the distal pair. Metatarsi IV without distal lateral spines. Palp femur with two or three dorsal and one prolateral spine, usually short, thin, except *E. lapidicola* which lacks palpal femur spines. All leg spines relatively short except metatarsi IV ventral spines which are longer. Legs usually with long erect setae but few adpressed setae. Scopula relatively long, sparse, on all metatarsi and tarsi. Abdomen may be flattened dorsoventrally, dorsal pattern consists of dark spots, or blackish with pale spots. Male cymbium may be with two or three prolateral spines or stout long bristles. Male palpal tibia with short retrolateral apophysis with small membranous support. Embolus long; from its base arcing around tegulum, running along prolateral side of cymbium before looping near tip for almost one complete turn. Conductor begins at prolateral side of tegulum following route of embolus to support tip of embolus. Embolic sclerite present with apex attenuated or rounded. Female epigynum small; well defined but weakly sclerotized lateral edges overhanging whitish fossa; lacking setae medially but with setae extending between sclerotized lateral sides at anterior edge of fossa. Fossa recessed anteriorly, whitish, posteriorly with pigmented 'plateau' formed by fusion of insemination duct bases to fossa. Vulva with one to one and a half insemination duct coils; spermathecal sacs absent.

Type species

Eodelena spenceri Hogg, 1902 by original designation and monotypy.

Remarks

Eodelena is removed from *Zachria* as it differs in the AME being larger than the ALE with the AME closer to each other than to the ALE, the carapace wider than long or at least not significantly longer than wide, most metatarsi longer than the tibiae and in the female by the absence of spermathecal sacs. *Eodelena* is similar in appearance to *Delena* from which it can be separated by the latter having in the male a highly coiled embolus and by the female having a larger fossa containing numerous setae medially. *E. lapidicola* is most similar to *Delena* in its large size, in having the carapace longer than wide, the sternum noticeably longer than wide and widest mid-length (Fig. 17), and a lack of distal spines on the palpal femur. It differs from *Delena* in having broader eye rows (Fig. 15), relatively shorter legs, longer palpal femur, and more leg spines in addition to the above genitalic differences.

Eodelena convexa is least likely to be confused with *Delena* and other *Eodelena* species as it possesses a convex carapace (Fig. 14) and more spinose legs. As in *E. lapidicola, E. convexa* has the carapace slightly longer than broad. The remaining *Eodelena* species have the carapace wider than long (Fig. 11) and with *convexa*, the sternum only slightly longer than wide and widest about ⅓ from the anterior edge (Fig. 13).

A key to the female *Eodelena* species is given but with the exception of *E. convexa* and *E. lapidicola*, care is required in their diagnosis as colour, size and epigynum shape are very similar and variable. *E. kosciuskoensis* and *E. loftiensis* differ from other known females in the fertilization and insemination duct coiling while *E. loftiensis* differs from *E. kosciuskoensis* in the slightly higher carapace and abdomen pattern. The female of *E. tasmaniensis* is separated from those of *E. melanochelis* and *E. spenceri* by the general darker colour and the smaller epigynum with more compact insemination duct coils and *E. melanochelis* differs from *E. spenceri* in its smaller size and the narrower epigynum.

Key To The Species Of *Eodelena*

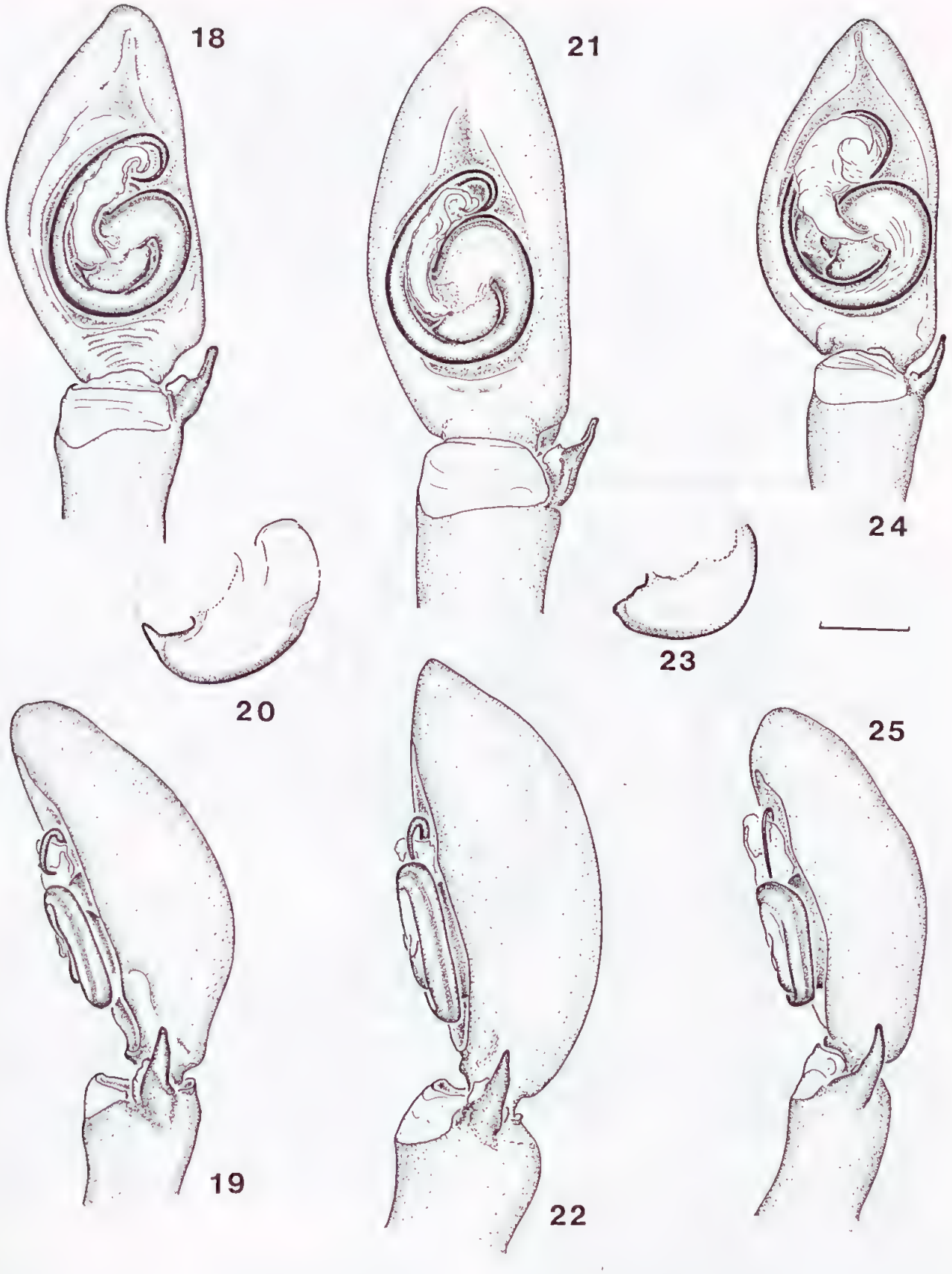
Males

1 — Carapace wider than long.....2
Carapace longer than wide.....5

2 — Embolic sclerite with attenuate or acute apex (Figs 20, 23).....3
— Embolic sclerite with rounded apex (Fig. 24)..
.....4

3 — Embolic sclerite narrow; apex attenuate (Fig. 20)
.....*spenceri* Hogg
— Embolic sclerite broad, short bluntly pointed apex (Fig. 23).....*melanochelis* (Strand)

4 — Carapace convex but low, abdomen with scattered blackish spots. Embolic base large, angular retrolaterally (Fig. 26); embolic sclerite small..
.....*loftiensis* sp. nov.
— Carapace flattish, abdomen with numerous blackish spots. Embolic base rounded retrolaterally; embolic sclerite relatively large (Fig. 24).....*tasmaniensis* sp. nov.



FIGURES 18–25. Left palpal tibia and tarsus, and embolic sclerite of male *Eodelena*. Figs 18–20, *E. spenceri*, holotype: 18, ventral; 19, retrolateral; 20, embolic sclerite. Figs 21–23, *E. melanochelis*, SAMA N1989589: 21, ventral; 22, retrolateral; 23, embolic sclerite. Figs 24–25, *E. tasmaniensis*, holotype: 24, ventral; 25, retrolateral. Scale line 0.5 mm except 20 and 23, 0.25 mm.

5 — Carapace convex, 4–6 mm long. Palpal femur with distal spines; palpal tarsus 2× longer than tibia, without prolateral spines.....*convexa* sp. nov.
— Carapace flat, 8–12 mm long. Palpal femur without distal spines; palpal tarsus subequal in length to tibia, with prolateral spines (Fig. 16).....*lapidicola* sp. nov.

Females

1 — Carapace wider than long, usually less than 8 mm long.....2
— Carapace longer than wide, 8–12 mm long.....*lapidicola* sp. nov.
2 — Fertilization ducts not enlarged to form coil, insemination ducts thin, membranous (Fig. 41).....3
— Fertilization ducts enlarged to form robust coil, insemination ducts partly or wholly sclerotized (Fig. 47).....5
3 — Abdomen yellowish with patches of dark suffusion.....4
— Abdomen largely with dark suffusion.....*tasmaniensis* sp. nov.
4 — Epigynum broad, sides parallel anteriorly (Fig. 40).....*spenceri* Hogg
— Epigynum narrow, sides incurved anteriorly (Fig. 42).....*melanochelis* (Strand)
5 — Carapace flattish, abdomen with dark suffusion.....*kosciuskoensis* sp. nov.
— Carapace slightly convex, abdomen spotted.....*loftiensis* sp. nov.

Eodelena spenceri Hogg
(Figs 7, 11, 12, 13, 18, 19, 20, 33, 39, 40, 41)

Eodelena spenceri Hogg, 1902: 464, fig. 104. Syntypes, ♂ and immature ♀, King Island [39°55′S, 144°00′E], Bass Strait, Australia, 1888, Professor Baldwin Spencer, BMNH 1888.144, examined.
Zachria spenceri: Simon, 1903: 1024.

Diagnosis
Male with relatively narrow embolic sclerite with apex long, attenuated. Female epigynum relatively parallel-sided anteriorly and as broad as long.

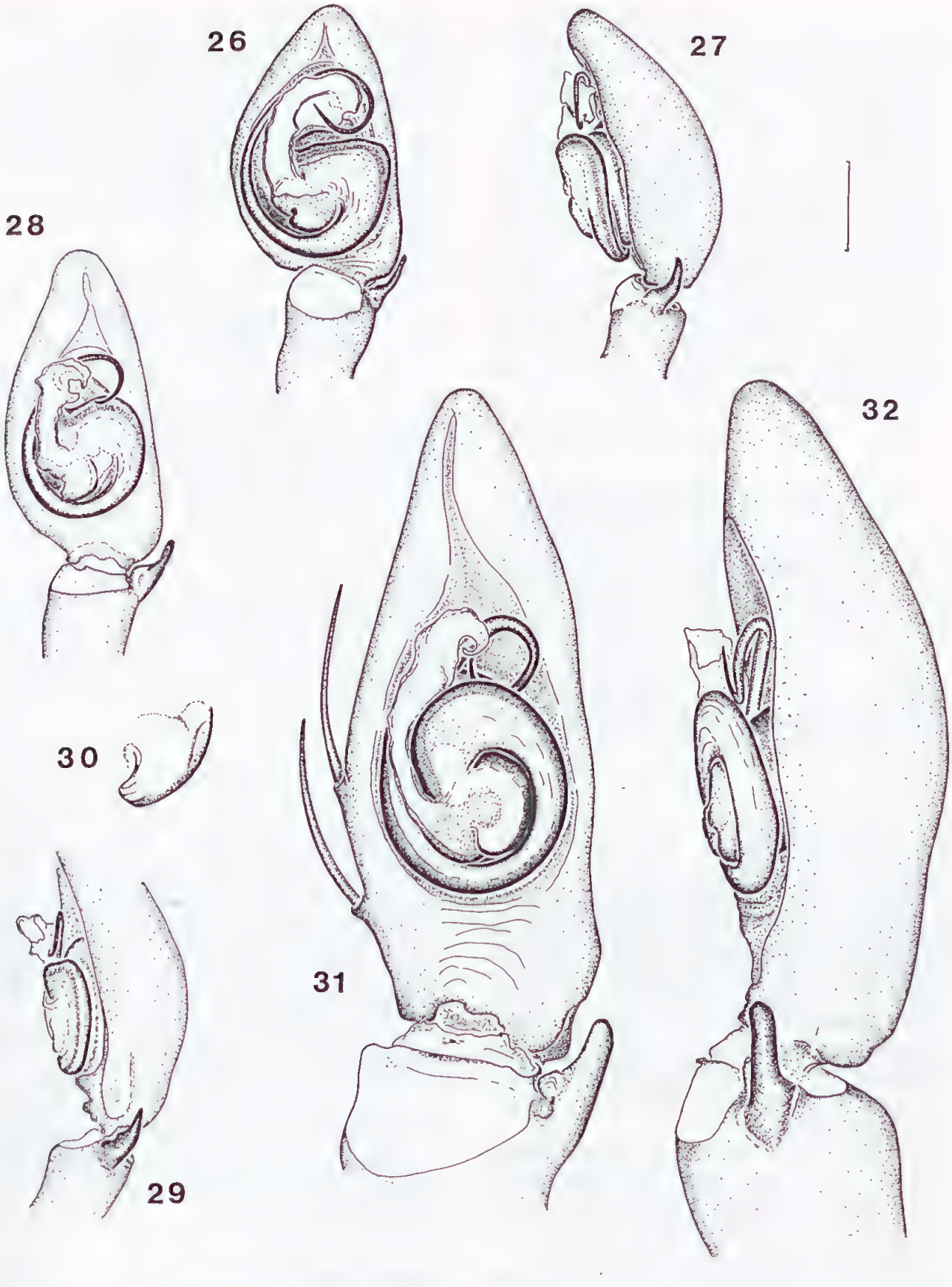
Syntype male
CL 5.90, CW 6.10. AL 6.70, AW 5.05.
Colour in alcohol: Carapace yellow-brown, striae brown but may be an artefact of preservation, caput yellowish with reddish lateral margins and ocular area. Chelicerae reddish; sparse long yellow-brown setae. Maxillae and labium orange-red. Sternum yellow; setae yellow-white. Coxae yellowish. Legs yellow-brown; femora yellowish ventrally, anterior tibiae and metatarsi orange-brown. Palpal tarsi orange-brown. Abdomen yellow-brown with brown-black suffusion forming spots.
Carapace: 6 to 7 times longer than high, highest posterior to fovea. Fovea indistinct in shallow depression. Chelicerae: retromarginal teeth 4. Eyes: AME 0.38. AME: ALE: PME: PLE = 1: 0.79: 0.63: 0.84. Interspaces: AME-AME 0.82, AME-ALE 1.26, PME-PME 2.21, PME-PLE 1.95, AME-PME 0.79, ALE-PLE 0.84. MOQ, aw: pw: 1 = 2.82: 3.47: 2.53. Width of clypeus to AME 0.32. Labium: L 0.91, W 1.31. Sternum: L 3.19, W 3.18. Legs: anterior leg ratios I = 4.7, II = 5.9. Upright setae sparse.
Palps: (Figs 18, 19). Embolic sclerite relatively narrow with long attenuate apex (Fig. 20).

Female TM J145 (as male except as follows)
CL 6.89, CW 7.14. AL 10.25, AW 7.20.
Colour in alcohol: Carapace yellowish, striae reddish, ocular area and lateral margins of caput reddish. Chelicerae dark reddish-brown; setae yellow-brown. Maxillae and labium orange-red. Sternum yellow, margins reddish. Leg coxae and femora yellowish, anterior metatarsi and tarsi orange-red. Palps orange-red. Abdomen (Fig. 33) yellow-brown with anterior yellow streak, blackish suffusion forming spots; venter yellow, blackish suffusion medially.
Eyes: AME 0.41. AME: ALE: PME: PLE = 1: 0.78: 0.63: 0.73. Interspaces: AME-AME 0.83, AME-ALE 1.37, PME-PME 2.29, PME-PLE 2.07, AME-PME 0.83, ALE-PLE 0.95. MOQ, aw: pw: 1 = 2.83: 3.56: 2.46. Width of clypeus to AME 0.27. Labium: L 0.96, W 1.58. Sternum: L 3.67, W 3.47. Legs: anterior leg ratios I = 4.1, II = 5.1.
Epigynum: (Fig. 41). Narrow anteriorly, broadest medially.

Variation
Carapace length of males 5.02–9.37, mean 6.99 (n = 8). The embolic sclerite may have much of the attenuate apex broken off or rounded, but along with the sclerite shape, remains distinct from *E. melanochelis*. Carapace length of females 5.78–8.50, mean 7.50 (n = 5). The usual form of the epigynum (Figs 39, 40) is broader anteriorly but is somewhat variable and occasionally may be similar to *E. melanochelis* in having the lateral sides curving inwards anteriorly (Fig. 41) rather than being parallel. The vulva has 1½ insemination duct coils.

Distribution
(Fig. 7). King Island, Bass Strait and northern and eastern Tasmania.

Other material examined
Tasmania: ♀, Blackmans Bay, 42°52′S, 147°51′E, 1924, SAMA N1989573; penult. ♂, same data, SAMA N1989574; ♂, Hermit Camp,



FIGURES 26–32. Left palpal tibia and tarsus, and embolic sclerite of male *Eodelena*. Figs 26–27, *E. loftiensis,* holotype: 26, ventral; 27, retrolateral. Figs 28–30, *E. convexa*, holotype: 28, ventral; 29, retrolateral; 30, embolic sclerite. Figs 31–32, *E. lapidicola,* holotype: 31, ventral; 32, retrolateral. Scale line 0.5 mm except 30, 0.25 mm.

(?Hermit Valley = 42°51′S, 146°09′E), 19. iii. 1972, H.D. B., A.P. A., TM J790; 4 ♂♂, Islands, Bass Strait, Dec. 1908, J. A. Kershaw, NMV; 3 ♀♀, King Island, 39°55′S, 144°00′E, Dec. 1906, J. A. Kershaw, NMV K-0957; ♂, Lake St Clair, 42°04′S, 146°10′E, Oct. 1937, A. W. G. Powell, TM J278; juv., Taroona, 42°57′S, 147°20′E, 15. ii. 1978, J. Parrott, TM J1296; ♂, ♀, Trevallyn, Launceston, 41°27′S, 147°10′E, V. V. Hickman, TM J145. Further material of 1 ♀, 2 ♂♂, 1 juv., labelled Adelaide, Jan. 1924, Cameron W, SAMA N1989575–8, is also considered to be from Tasmania. The locality 'Adelaide' is typed on a separate label while the hand written label with date and collector is similar to that of the Blackmans Bay specimens (also dated 1924).

Eodelena melanochelis (Strand) **comb. nov.**
(Figs 7, 21, 22, 23, 34, 42, 43)

Zachria melanochelis Strand, 1913: 204. Holotype ♀, Victoria. H. and A. Eberhard. Whereabouts unknown.

Diagnosis

Male embolic sclerite broad with a short, bluntly pointed apex. Female epigynum relatively long and narrow.

Male SAMA N1989589

CL 7.42, CW 7.71. AL 7.65, AW 5.20.

Colour in alcohol: Carapace creamy-yellow, caput reddish on lateral margins and around posterior eye row; clypeus and around anterior eye row dark red-brown. Chelicerae black. Maxillae and labium reddish. Sternum yellow. Coxae and basal half of femora creamy-yellow, remainder of leg segments orange-yellow, darker on metatarsi and tarsi. Abdomen yellow-brown with blackish suffusion forming spots. Venter with median pale yellow area with blackish suffusion.

Carapace: Low; sides gently sloping, flattish medially, 6 to 7 times longer than high, highest posterior to fovea. Fovea in shallow depression. Eyes: AME 0.46. AME: ALE: PME: PLE = 1: 0.78: 0.61: 0.78. Interspaces: AME-AME 0.70, AME-ALE 1.26, PME-PME 2.22, PME-PLE 2.06, AME-PME 0.67, ALE-PLE 0.85. MOQ, aw: pw: 1 = 2.70: 3.43: 2.13. Width of clypeus to AME 0.19. Labium: L 1.02, W 1.45. Sternum: L 3.98, W 3.59. Broadest ⅓ length from anterior. Legs: anterior leg ratios I = 4.4, II = 5.4. Upright setae sparse.

Palps: (Figs 21, 22). Embolic sclerite broad with short bluntly pointed apex (Fig. 23).

Female SAMA N1989592 (as male except as follows)

CL 6.70, CW 7.20. AL 10.45, AW 7.30.

Colour in alcohol: Caput with orange-red lateral margins and around ocular area; orange-red suffusion medially, dark red-brown between ALE-PLE and between AME. All eyes with blackish rims. Chelicerae glossy blue-black. Maxillae and labium orange-red, maxillae with dark brown prolateral patch. Sternum creamy-yellow. Abdomen (Fig. 34).

Eyes: AME 0.40. AME: ALE: PME: PLE = 1: 0.88: 0.70: 0.90. Interspaces: AME-AME 0.93, AME-ALE 1.38, PME-PME 2.18, PME-PLE 2.20, AME-PME 0.85, ALE-PLE 0.90. MOQ, aw: pw: 1 = 2.93: 3.58: 2.40. Width of clypeus to AME 0.33. Labium: L 1.00, W 1.58. Sternum: L 3.79, W 3.51. Legs: anterior leg ratios I = 4.0, II = 4.8.

Epigynum: (Figs 42, 43). Broader in anterior half; posterior 'plateau' long with procurved anterior edge. Vulva with a little over one complete coil of the insemination duct.

Variation

Carapace lengths of males 5.66–7.42, mean 6.45 (n=5). Carapace lengths of females 5.34–6.90, mean 6.16 (n=7). One female from Icy Creek with much darker abdomen more similar in pattern to *E. tasmaniensis.*

Distribution and remarks

(Fig. 7). Occurs in southern Victoria to the alpine area of Mt Buffalo. *E. melanochelis* is very common in the Dandenong Ranges where it is found in lengths of tightly rolled bark hanging from *Eucalyptus* or from the undergrowth beneath *Eucalyptus.* The male differs from *E. spenceri* in the relatively shorter and broader embolic sclerite with short pointed apex and the female by the smaller size and narrower epigynum with lateral sides curved inwards anteriorly.

The redescription is from recently collected material which is considered to have come from near the type locality. Although the collectors of the type material were from Melbourne, a specimen of *Lampona obscoena* L. Koch from Gippsland, Victoria, was mentioned in the same paper. It may be assumed that the types of *melanochelis* came from within those areas.

Material examined

Victoria: ♀, Belgrave, 37°55′S, 145°21′E, 12. vi. 1989, D. Hirst, SAMA N1989592; ♀, same data, SAMA N1989593; ♀, Blackwood, 37°29′S, 144°19′E, 26. vi. 1980, H. Parnaby, AM KS19695; ♀, juv., same locality, 10. x. 1977, H. Parnaby, AM KS19287; ♀ and spiderling, Emerald, 37°56′S, 145°27′E, 12. vi. 1989, D. Hirst, SAMA

N1989594–5; 1 ♂, 2 ♀♀, 4 km NE Icy Creek, 37°51′S, 146°07′E, 11. vi. 1989, D. Hirst, SAMA N1989589–91; juv. Macclesfield district, *ca* 37°54′S, 145°30′E, Aug. 1904, E. J., NMV; 2 ♂♂, camping area, Lake Catani, Mt Buffalo, 36°44′S, 146°49′E, 21. ii. 1979, H. Parnaby, AM KS19288; ♂, Pirron Yallock, 38°21′S, 143°24′E, 19. vi. 1989, D. Hirst, SAMA N1989588; ♂, no data, AM KS19289.

Eodelena tasmaniensis sp. nov.
(Figs 7, 24, 25, 35, 44, 45)

Types

Holotype: ♂, Olga Valley, 42°43′S, 145°46′E, (HEC transect 2L.6445), south-west Tasmania, 20. i. 1977, C. Howard and G. Johnston, TM J1486.

Allotype: ♀, Wedge River, Gordon Road (*ca* 42°45′S, 146°12′E) south-west Tasmania, 21. iii. 1972, A.P. A. and H.D. B., TM J789.

Paratypes: ♂, Junction Creek, W. Arthur Plains, 43°07′S, 146°18′E, 8. ii. 1966, Neboiss, NMV K-0915; ♀, same data, NMV K-0916.

Diagnosis

Abdomen blackish with small yellowish spots. Male embolic sclerite with broad rounded apex. Female epigynum horse-shoe shaped in anterior half.

Holotype male

CL 5.25, CW 5.26. AL 6.10, AW 4.40.

Colour in alcohol: Carapace orange-red with brown suffusion on lateral edges, striae and ocular area; numerous short dark brown setae around fovea. Chelicerae dark red-brown to blackish. Maxillae and labium orange-brown. Sternum yellowish. Legs yellow proximally; orange-red on femora distally and to tarsi. Abdomen dorsally with pale areas largely obscured by dark pigment. Venter dark with pale bordered median area containing dark pigment.

Carapace: Flattish, 6.5 to 7 times longer than high, highest posterior to fovea. Fovea indistinct in shallow depression. Eyes: AME 0.38. AME: ALE: PME: PLE = 1: 0.79: 0.58: 0.68. Interspaces: AME-AME 0.68, AME-ALE 0.97, PME-PME 1.79, PME-PLE 1.63, AME-PME 0.66, ALE-PLE 0.74. MOQ, aw: pw: 1 = 2.58: 3.00: 2.05. Width of clypeus to AME 0.21. Labium: L 0.70, W 1.12. Sternum: L 2.80, W 2.62. Legs: anterior leg ratios I = 4.2, II = 5.2.

Palps: (Figs 24, 25). Palpal tibial apophysis relatively longer than in preceding species. Embolic sclerite with broadly rounded apex. Embolus relatively short, distally with less than a ¾ turn.

Allotype female (as holotype except as follows)

CL 6.32, CW 6.29. AL 9.24, AW 6.30.

Colour in alcohol: Abdomen (Fig. 35).

Eyes: AME 0.40. AME: ALE: PME: PLE = 1: 0.80: 0.65: 0.75. Interspaces: AME-AME 0.85, AME-ALE 1.40, PME-PME 2.35, PME-PLE 1.95, AME-PME 0.75, ALE-PLE 1.00. MOQ, aw: pw: 1 = 2.85: 3.65: 2.35. Width of clypeus to AME 0.3. Labium: L 0.86, W 1.38. Sternum: L 3.17, W 3.06. Legs: anterior leg ratios I = 3.7, II = 4.6.

Epigynum: (Fig. 44). Small, somewhat rounded in anterior half.

Variation

Carapace length of males 4.41–7.03, mean 5.72 (n=2). Carapace length of females 5.91–7.25, mean 6.52 (n=3). Vulva of paratype NMV K-0916 (Fig. 45) with small compact insemination ducts.

Distribution and remarks

Known only from south-western Tasmania (Fig. 7). While the much darker general colour separates this species from the only other known Tasmanian species, *E. spenceri*, specimens of *E. kosciuskoensis* from the southern alpine area of NSW are also of comparable dark colouring but differ from *E. tasmaniensis* in the robust fertilization ducts. *E. tasmaniensis* differs from *E. spenceri* in the broad, rounded embolic sclerite in the male and the relatively small, rounded fossa of the female.

Other material examined

Tasmania: ♂, penult. ♂, 3 juv., Franklin River area, 42°27′25″S, 145°43′45″E, 14. i. 1983, ANZSES Exped., QM S14146; ♀, juv., same locality, Jan., 1983, ANZSES Exped., QM S14147; penult. ♂, Maatsuyker Island, 43°39′S, 146°16′E, 10. xi. 1970, P. Rawlinson, TM J712; ♀, Picton area (*ca* 43°10′S, 146°40′E), 27. xi. 1962, C. McCubbin, NMV; juv., same data as allotype, TM J789.

Etymology

The name reflects its known distribution as being endemic to Tasmania.

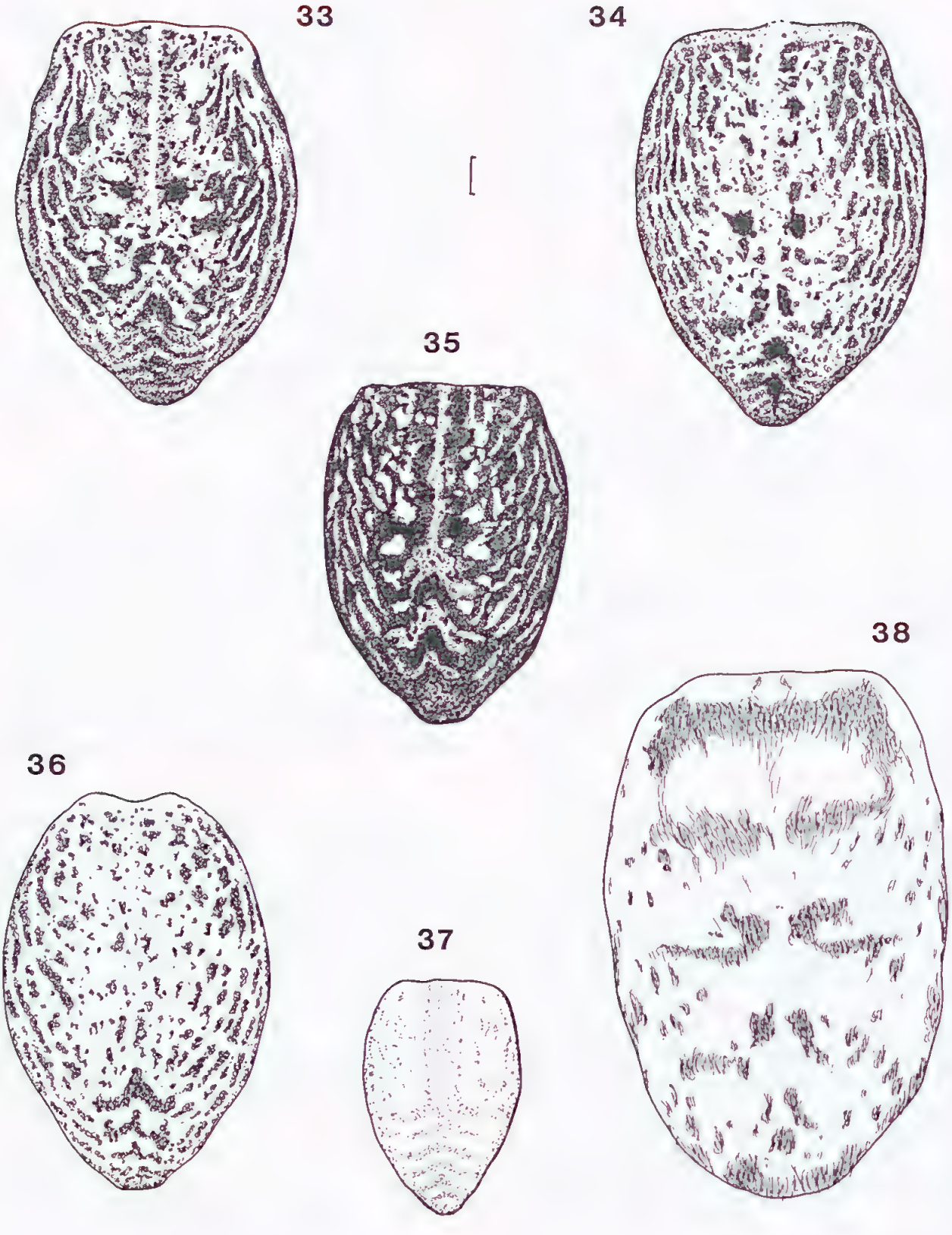
Eodelena kosciuskoensis sp. nov.
(Figs 7, 48, 49)

Type

Holotype: ♀, inside curled shed ribbon bark of eucalypt, on ground, 12 km S Thredbo (36°30′S, 148°19′E), Grid 147 476 on 1:100,000, New South Wales, 31. xii. 1983, H. Parnaby, AM KS19286.

Diagnosis

(Male unknown). Carapace flattish. Abdomen



FIGURES 33–38. *Eodelena* abdomens, dorsal pattern. 33, *E. spenceri*, TM J145, female; 34, *E. melanochelis*, SAMA N1989593, female; 35, *E. tasmaniensis*, allotype female; 36, *E. loftiensis*, allotype female; 37, *E. convexa*, holotype male; 38, *E. lapidicola*, allotype female. Scale line 1 mm.

dark coloured. Female with robust fertilization ducts and small sclerotized insemination duct coils.

Female

CL 5.18, CW 5.77. (Abdomen damaged) AL *ca* 7.0, AW *ca* 5.0.

Colour in alcohol: Carapace yellow-brown, margins of caput orange-brown, ocular area and clypeus with dark brown suffusion; setae brown. Chelicerae brown-black. Maxillae and labium orange-brown. Sternum yellow with orangish margins; sparse greyish setae. Coxae yellow; grey setae. Leg femora yellowish; patellae to tarsi orange-brown. Abdomen with epidermis partly lifted, yellow-brown with blackish suffusion.

Eyes: AME 0.35. AME: ALE: PME: PLE = 1: 0.71: 0.6: 0.74. Interspaces: AME-AME 0.74, AME-ALE 1.14, PME-PME 2.11, PME-PLE 1.89, AME-PME 0.86, ALE-PLE 0.91. MOQ, aw: pw: 1 = 2.74: 3.31: 2.46. Width of clypeus to AME 0.29. Labium: L 0.79, W 1.25. Sternum: L 3.02, W 2.84. Legs: anterior leg ratios I = 4.5, II = 5.6.

Epigynum: Rounded in anterior half, slightly narrowing towards posterior (Fig. 48). Fertilization ducts robust and heavily sclerotized (Fig. 49).

Distribution and remarks

(Fig. 7). Known only from within the Kosciusko National Park, New South Wales, hence the specific epithet. The holotype female is damaged and the abdomen pattern partly destroyed by lifting of the epidermis. Two juveniles from Tumut Reservoir have even darker abdomens. *E. kosciuskoensis* differs from *E. loftiensis* in the smaller, robust fertilization ducts and insemination ducts, the flatter carapace and darker abdomen pattern.

Other material examined

New South Wales: 2 juv., Tumut Reservoir, 35°58′S, 148°25′E, 22. v. 1988, D. Hirst, SAMA N1989596-7.

Eodelena loftiensis sp. nov.
(Figs 7, 26, 27, 36, 46, 47)

Types

Holotype: ♂, in rolled bark, Loftia Park, 35°02′S, 138°42′E, Mount Lofty Ranges, South Australia, 14. ix. 1989, J. A. Forrest, SAMA N1989579.

Allotype: ♀, same data as holotype, but L. N. Nicolson, SAMA N1989580.

Paratypes: ♀, same data as holotype, but D. Hirst, SAMA N1989582; ♀, under bark of *Eucalyptus*, Loftia Park, South Australia, 25. iii. 1984, R. V. Southcott, SAMA N1989581; ♂, Loftia Park, in rolled bark with immature female, 27. iii. 1990, D. Hirst, SAMA N1989616.

Diagnosis

Carapace low, slightly convex. Abdomen pale with numerous small blackish spots. Male embolic base large, angular retrolaterally; embolic sclerite small, apex bluntly extended and rounded. Female with small insemination ducts coiled one and a half times and enlarged fertilization ducts coiled once.

Holotype male

CL 3.34, CW 3.59. AL 4.19, AW 2.68.

Colour in alcohol: Carapace creamy-yellow; brown suffusion on lateral sides; caput with yellow lateral margins, clypeus and ocular area orangish; dark brown in median ocular quadrangle. Chelicerae dark red-brown. Labium orange, maxillae yellow with orange patch prolaterally. Sternum yellowish. Coxae and femora proximally creamy, remainder of legs orange-red but tarsi yellow-brown. Abdomen pale yellow-brown with spots formed by dark setae and pigment, yellowish anterior streak; venter yellow-brown.

Carapace: Low convex, 5 times longer than high, highest posterior to fovea. Fovea indistinct in shallow depression. Setae relatively long. Eyes: AME 0.25. AME: ALE: PME: PLE = 1: 0.8: 0.72: 0.83. Interspaces: AME-AME 0.76, AME-ALE 0.78, PME-PME 1.84, PME-PLE 1.64, AME-PME 0.79, ALE-PLE 0.92. MOQ, aw: pw: 1 = 2.76: 3.28: 2.44. Width of clypeus to AME 0.36. Chelicerae: retromargin with 3 subequal teeth. Labium: L 0.45, W 0.82. Sternum: L 1.82, W 1.92. Legs: anterior leg ratios I = 4.8, II = 7.6.

Palps: (Figs 26, 27). Tibial apophysis long, thin, slightly curved. Embolic base large retrolaterally, embolic sclerite with rounded apex.

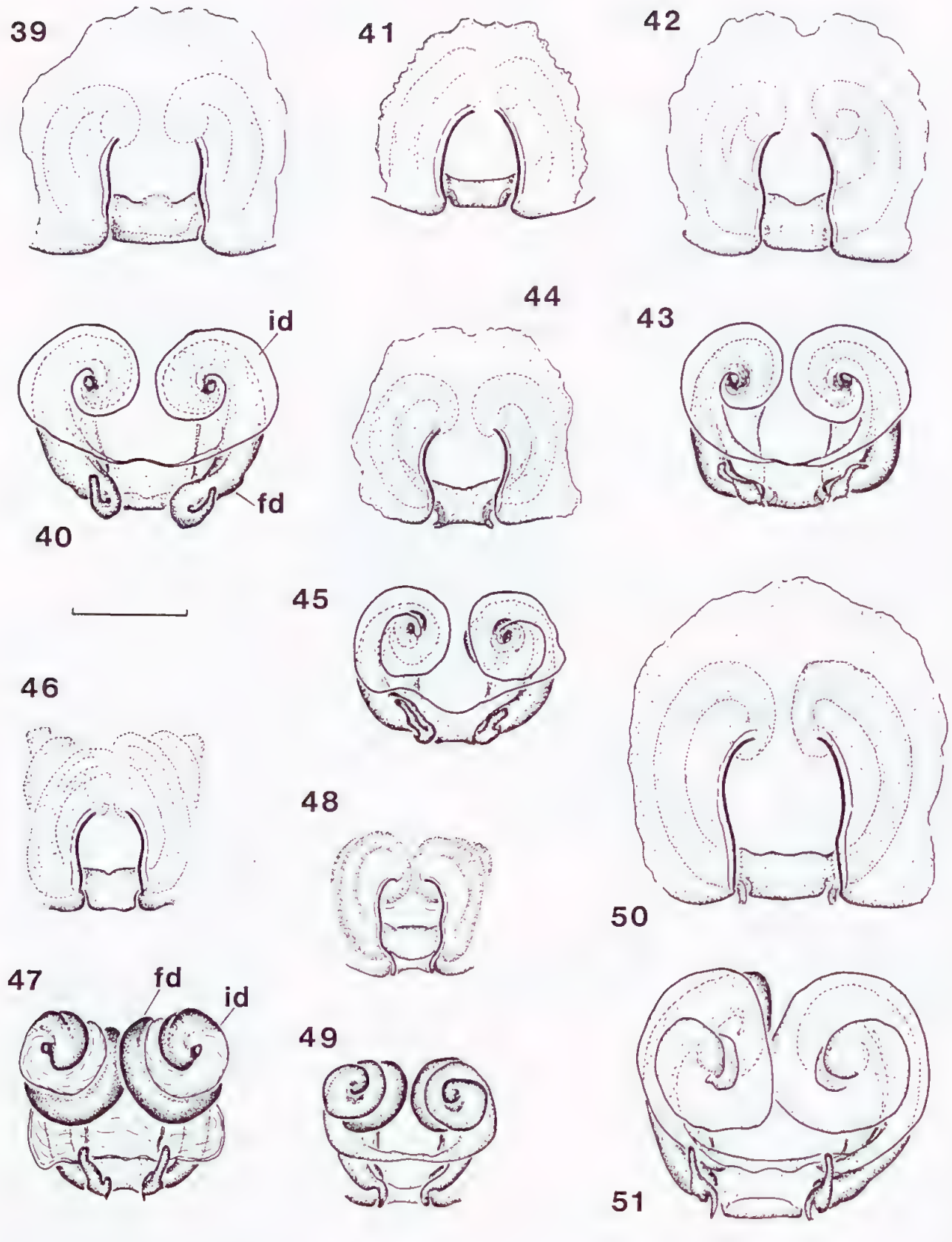
Allotype female (as holotype except as follows)

CL 5.02, CW 5.18. AL 10.50, AW 6.92.

Colour in alcohol: Chelicerae blackish, shiny. Maxillae orangish; brown prolateral patch. Sternum creamy-yellow. Metatarsi reddish. Abdomen (Fig. 36).

Eyes: AME 0.36. AME: ALE: PME: PLE = 1: 0.75: 0.67: 0.72. Interspaces: AME-AME 0.72, AME-ALE 1.06, PME-PME 1.94, PME-PLE 2.03, AME-PME 0.69, ALE-PLE 1.06. MOQ, aw: pw: 1 = 2.72: 3.28: 2.28. Width of clypeus to AME 0.17. Chelicerae: left chelicera with 4 teeth, basal minute, others subequal. Labium: L 0.71, W 1.19. Sternum: L 2.61, W 2.52. Legs: anterior leg ratios I = 4.2, II = 5.2. Upright setae more numerous than in the male.

Epigynum: (Figs 46, 47). Relatively shorter and broader than other species, somewhat parallel sided. Vulva with small insemination ducts coiled 1½



FIGURES 39–51. *Eodelena* female epigyna and vulvae, cleared. Figs 39–41, *E. spenceri:* 39, epigynum and vulva of NMV K-0957, ventral; 40, vulva of NMV K-0957, dorsal; 41, epigynum of TM J145. Figs 42–43, *E. melanochelis*, SAMA N1989592: 42, epigynum and vulva, ventral; 43, vulva, dorsal. Figs 44–45, *E. tasmaniensis*, paratype NMV K-0916: 44, epigynum and vulva, ventral; 45, vulva, dorsal. Figs 46–47, *E. loftiensis*, paratype SAMA N1989581: 46, epigynum and vulva, ventral; 47, vulva, dorsal. Figs 48–49, *E. kosciuskoensis*, holotype: 48, epigynum and vulva, ventral; 49, vulva, dorsal. Figs 50–51, *E. lapidicola*, paratype WAM 88/1979: 50, epigynum and vulva, ventral; 51, vulva, dorsal. Scale line 0.5 mm. id, insemination duct; fd, fertilization duct.

times and enlarged fertilization ducts with one coil, together appearing as being continuously coiled 2½ times.

Variation

Carapace length of paratype male 3.56. Carapace length of females 4.40–5.46, mean 4.78 (n=7).

Distribution and remarks

E. loftiensis is considered to be restricted to the high rainfall areas of the Mount Lofty Ranges in South Australia (Fig. 7). The specific epithet refers to the type locality, Loftia Park. Two females were collected with egg-sacs, one subsequently being destroyed. Eggs are loosely held in place against the substrate by a thin covering of silk from which they are easily dislodged. Differs from other species in the male having the embolic base enlarged retrolaterally, angular in shape, and the female having enlarged fertilization ducts.

Other material examined

South Australia: 5 ♀♀, Loftia Park, 21. ix. 1989, D. Hirst, N. Nicolson, C. Bonnielle, SAMA N1989583–7; penult. ♂, same data, SAMA N1990714.

Eodelena convexa sp. nov.
(Figs 7, 14, 28, 29, 30, 37)

Types

Holotype: ♂, Wanneroo, 31°45′S, 115°48′E, Western Australia, 23. iii. 1979, E. Bruen, WAM 86/681.

Paratypes: ♂, Dianella, 34°12′S, 115°04′E, Western Australia, 25. iii. 1976, A. Harding, WAM 88/1644; ♂, Gomm Spring, 34°09′S, 115°24′E, 28 km E by N of Karridale, Western Australia, 24. iv. 1983, E. S. Nielsen, E. D. Edwards, ANIC; ♂, Jandakot, Perth, Western Australia, Mar. 1977, R. P. McMillan, WAM 88/2136.

Diagnosis

(Female unknown). Carapace low convex; width subequal to length. Abdomen pale with faint pattern, embolic base rounded, embolic sclerite small.

Holotype male

CL 4.50, CW 4.45. AL 6.20, AW 4.10.

Colour in alcohol: Carapace yellow, caput darker, clypeus and ocular area reddish, dark brown pigment around eyes. Chelicerae dark reddish, darker near fang base. Maxillae and labium yellow-brown. Sternum yellow. Legs yellowish proximally; metatarsi and tarsi yellow-orange. Palps yellow-brown. Abdomen (Fig. 37) dorsally yellowish with faint reddish-brown markings; venter pale yellow. Spinnerets yellow-brown.

Carapace: Low convex, about 4 times longer than high, highest medially. Fovea a long shallow groove. Eyes: AME 0.34. AME: ALE: PME: PLE = 1: 0.76: 0.76: 0.76. Interspaces: AME-AME 0.65, AME-ALE 0.70, PME-PME 1.53, PME-PLE 1.53, AME-PME 1.00, ALE-PLE 0.76. MOQ, aw: pw: 1 = 2.59: 3.06: 2.35. Width of clypeus to AME 0.47. Labium: L 0.59, W 0.94. Sternum: L 2.34, W 2.26. Legs: anterior leg ratios I = 4.8, II = 5.5.

Palps: (Figs 28, 29). Palpal tibial apophysis positioned more dorsally, broader at base with an acutely pointed apex. Embolic base high, rounded. Embolic sclerite small; apex rounded with crenulate appearance (Fig. 30).

Variation

Carapace length of paratype males 4.69, 4.85 and 5.45. The apex of the embolic sclerite may have a smooth rounded appearance rather than crenulate, due to a more even distribution of pigment.

Distribution and remarks

(Fig. 7). Known only from the male, this species is found in south-west Western Australia. Differs from all other species by the pale abdomen with faint pattern and from the other known Western Australian species, *E. lapidicola*, by the convex carapace, smaller size, and the relative lengths and spination of palp segments. *E. convexa* is most similar to the male of *E. loftiensis* but the latter has the carapace wider than long and a retrolaterally angular embolic base. From the similar carapace shape and somewhat similar embolic base of *E. convexa* and *E. loftiensis* it is plausible to assume the female of *convexa* will also have a robust sclerotized vulva and the two species above, along with *E. kosciuskoensis*, may be originally derived from a single species which enjoyed a continuous southern distribution before becoming separated as a result of climatic changes.

Etymology

The specific epithet is in reference to the obviously convex carapace.

Material examined

Only the types.

Eodelena lapidicola sp. nov.
(Figs 7, 15, 16, 17, 31, 32, 38, 50, 51)

Types

Holotype: ♂, Yallingup, 33°39′S, 115°02′E, Western Australia, 18. ii. 1974, L. E. Koch, WAM 88/1584.

Allotype: ♀, Bremer Bay, 34°26′S, 119°23′E, Western Australia, June 1976, WAM 88/1499.

Paratypes: ♀, Salisbury Island, 34°22′S, 123°33′E, Recherche Archipelago, Western Australia, 17. iv. 1982, Burbidge and Fuller, WAM 88/1979; ♂, same data, WAM 88/1980.

Diagnosis

Distal spines on an unusually long palpal femur absent. Maxillae narrower in anterior half and sternum widest at mid-length. Male with palpal tarsus subequal in length to tibia. Female epigynum relatively broad and long with posterior 'plateau' short.

Holotype male

CL 11.67, CW 11.31. AL 13.50, AW 8.55.

Colour in alcohol: Carapace yellowish, caput margins and ocular area reddish; reddish suffusion. Chelicerae blackish; long yellowish setae. Maxillae and labium orange-red. Sternum yellow, margins reddish. Leg coxae and femora yellow; patellae to tarsi yellow-orange. Palps orange-red. Abdomen yellow-brown with blackish suffusion and brown setae forming pattern; venter pale yellow with orangish setae.

Carapace: Flattened, 11 times longer than high, highest in ocular region. Fovea indistinct in large depression. Eyes: AME 0.53. AME: ALE: PME: PLE = 1: 0.87: 0.64: 0.83. Interspaces: AME-AME 1.02, AME-ALE 2.04, PME-PME 2.87, PME-PLE 3.04, AME-PME 0.79, ALE-PLE 1.21. MOQ, aw: pw: 1 = 3.02: 4.15: 2.38. Width of clypeus to AME 0.38. Chelicerae: retromarginal teeth 4, distal well spaced from subdistal tooth. Labium: L 2.08, W 2.28. Sternum: L 6.26, W 4.91. Legs: anterior leg ratios I = 3.9, II = 4.7.

Palps: (Figs 31, 32). Palpal tarsus subequal in length to tibia (Fig. 16) with 3 prolateral spines. Embolic sclerite short; rounded apex not extending to prolateral side.

Allotype female (as holotype except as follows)

CL 11.48, CW 11.22. AL 14.00, AW 8.70.

Colour in alcohol: Carapace yellow, caput with reddish ocular area and lateral margins. Chelicerae dark red-brown. Maxillae reddish but with yellowish patch posteriorly. Abdomen (Fig. 38).

Eyes: AME 0.54. AME: ALE: PME: PLE = 1: 0.89: 0.54: 0.78. Interspaces: AME-AME 0.91, AME-ALE 1.93, PME-PME 2.85, PME-PLE 2.91, AME-PME 0.74, ALE-PLE 1.22. MOQ, aw: pw: 1 = 2.89: 4.00: 2.33. Width of clypeus to AME 0.28. Labium: L 1.90, W 2.22. Sternum: L 6.31, W 4.68. Legs: anterior leg ratios I = 3.7, II = 4.5.

Epigynum: Relatively broad with 'plateau' of fossa short. Vulva of WAM 88/1979 (Figs 50, 51) with 1½ insemination duct coils.

Variation

Carapace length of males 8.37–11.67, mean = 10.52 (n=3). Carapace length of females 8.82–11.99, mean = 10.07 (n=7).

Distribution and remarks

Confined to offshore islands and moist coastal areas of south-west Western Australia (Fig. 7). It has been collected in most cases from under rocks. *E. lapidicola* differs from all other species in the shape of the carapace, sternum, maxillae and in the palp spination and short tarsus.

Etymology

The specific epithet refers to its habit of living under rocks.

Other material examined

Western Australia: ♀, Bald Island, 34°55′S, 118°27′E, 29. x. 1971, A. A. Burbidge, WAM 88/1496; juv., same data, WAM 88/1497; ♂, under loose granite, Barker Bay, Albany district (probably Barker Inlet, 33°48′S, 121°20′E, Esperance district), 28. i. 1965, R. Humphries, WAM 88/1495; ♀ Boxer Island, 34°00′S, 121°41′E, Recherche Archipelago, 1950, V. Serventy, WAM 55/4996; ♀, Cape Leeuwin, 34°22′S, 115°08′E, July 1914, W. B. Alexander, WAM 14/994; penult. ♂, Eclipse Island, 35°11′S, 117°53′E, 27. i. 1938, A Blythe, WAM 38/141; ♀, Figure of Eight Island, 34°02′S, 121°37′E, Recherche Archipelago, 1950, V. Serventy, WAM 55/4990; juv., Lucky Bay, Cape le Grand, 34°00′S, 122°14′E, 19. v. 1977, R. P. McMillan, WAM 88/1545; juv., same data, WAM 88/1546; penult. ♂, Salisbury Island, 34°22′S, 123°33′E, 17. iv. 1972, N. McKenzie, WAM 88/1978; ♀, Two People Bay, 34°57′S, 118°11′E, 21. iv. 1982, G. T. Smith, WAM 88/1581; juv., same data as holotype, WAM 88/1585. [The Recherche Archipelago material collected by V. Serventy was listed by Main (1954: 47) as *Delena cancerides* and field-notes on habits by V. Serventy were given.]

Species Transferred

Although the female syntype of *Eodelena nigrifrons* Simon (1908) has not been located, a juvenile syntype in ZMB has been examined and is considered to belong to *Delena*. Further material seen (unpubl. data) from SAMA and WAM shows *Delena nigrifrons* (Simon) to be a valid new combination.

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BRACHIOPPIELLA SPECIES (ACARI: ORIBATIDA: OPPIIDAE) FROM SOUTH AUSTRALIAN SOILS

D. C. LEE & L. S. SUBIAS

LEE, D. C. & SUBIAS, L. S., 1991. *Brachioppiella* species (Acari: Oribatida: Oppiidae) from South Australian soils. *Rec. S. Aust. Mus.* 25(1): 19–30.

As part of a study of oribate mites from South Australian soils, the genus *Brachioppiella* Hammer, 1962 is reviewed and the following four new species are described: *Brachioppiella* (*Brachioppiella*) *paranasalis*, *Brachioppiella* (*Gressittoppia*) *magna*, *B.* (*G.*) *minima*, *B.* (*G.*) *pseudohigginsi*. Brachioppiinae Subias, 1989 is commented on and a key to the adults of all Australian genera, subgenera and species is provided.

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As a result of studies done in South Australia on the advanced oribate mites (Planofissurae, see Lee (1987)) of soils, numerous adults belonging to the family Oppiidae Grandjean, 1951 were extracted. Amongst them, the subfamily Brachioppiinae Subias, 1989 in Subias & P. Balogh (1989) were only represented by members of the genus *Brachioppiella* Hammer, 1962. These are described here using the notation and systematic framework (as implied by the taxon definitions and keys) of Subias & Balogh (1989). The Brachioppiinae are commented on and, because some of the included genera are very similar to *Brachioppiella*, keys are provided for all the Australian taxa.

Information on all the nine florally diverse sites which were sampled is given by Lee (1981), *Brachioppiella* having been collected from only four of these sites. Measurements are in micrometres (μm). All the material was collected by one of us (D.C.L.). The specimens are mostly deposited in the South Australian Museum (SAMA), but also in the Faculty of Biology of the Universidad Complutense of Madrid (FBUCM), the Field Museum of Natural History, Chicago (FMNH) or the New Zealand Arthropod Collection, D.S.I.R., Auckland (NZAC).

SYSTEMATICS

Brachioppiinae Subias

Brachioppiinae Subias in Subias & P. Balogh, 1989: p. 370.

Diagnosis (Adults)

Oppiidae. Genital and anal plates usually normal length and well separated. Epimeres III and IV not usually reaching behind genital plates, but if they do, then apodemes IV present. Crista notogastra absent. Seta *c*2 absent or less developed than other notogastral setae. Interbothridial tubercles usually absent. Anterior margin of notogaster lacks both protruding humeral processes and interbothridial costula. Lamellar and/or translamellar lines present. Fissurae *iad* inverse apoanal. Sensillus either pectinate, radiate or ciliate.

Distribution

The Brachioppiinae are restricted to the major southern regions (Neotropical, Ethiopian, Oriental, Australasian, Subantarctic and Antarctic). Few records are from the Northern Hemisphere or the tropics. Mostly the species are from moist southern temperate locations, indicating a Gondwanan distribution.

Within Australia all the records are from outside the tropics, either from Queensland, New South Wales or South Australia. The Queensland records are from dry or wet sclerophyll forest, the New South Wales records are from subtropical rainforest, whilst the South Australian records are from dry sclerophyll or cultivated pine forest, or from woodland or closed scrubland with a substantial litter layer. None of the records are from the extensive drier Australian regions with open vegetation and sparse litter.

Remarks

The Brachioppiinae include genera which were placed in five separate subfamilies in the classification of J. Balogh (1983). It is particularly similar to three subfamilies (Arcoppiinae J. Balogh, 1983, Lanceoppiinae J. Balogh, 1983 and Oppiinae Grandjean, 1951) amongst these five subfamilies, which lack protruding humeral notogastral processes. It is also very similar to the Multioppiinae J. Balogh, 1983. In distinguishing Brachioppiellinae

from these four subfamilies, four characters are important: the shape of the sensillus, the presence or absence of prodorsal lines, the number of genital setae and the position of the paranal fissurae (*iad*). This last diagnostic character excludes *Gressittoppia luxtoni* Ayyildiz, 1989, a species superficially very similar to members of the Brachioppiinae, to be grouped in the Multioppiinae.

In the distinguishing of brachioppiine genera, the number of genital setae is given considerable value. Whilst this is considered reliable in classifying species with six pairs as compared with fewer pairs (as it also is in distinguishing the subfamily Arcoppiinae from the Multioppiinae), the differentiating of species with either four or five pairs into separate genera is sometimes considered unreliable. The unreliability is demonstrated by *Brachioppiella* (*Gressittoppia*) *magna* in this paper, since it usually has four pairs, but on only one female there are five pairs of genital setae. Despite this, four as opposed to five genital setae is still used, as by Subias & P. Balogh (1989), in order to recognise the subgenera of *Brachioppiella*, although it is pointed out under the remarks on *B.* (*Gressittoppia*) that this division into subgenera may not be valid.

The following five genera or subgenera are known from Australia: *Brachioppiella* (*Brachioppiella*) Hammer, 1962; *Brachioppiella* (*Gressittoppia*) Balogh, 1983 (here recorded from Australia for the first time); *Brassoppia* (*Brassoppia*) Balogh, 1983; *Ctenoppia* Balogh, 1983; *Kokoppia* Balogh, 1983.

Key To Australian Brachioppiinae (Adults)

1 — Sensillus large, length more than distance between it and rostral setae. Prodorsum large, length more than 0.66 × length of notogaster....*Ctenoppia* Balogh 2

— Sensillus medium length, less than 0.75 × distance between it and rostral setae. Prodorsum size normal, length less than 0.66 × length of notogaster. 3

2 — Notogastral setae long (*e.g.* length of seta *la* more than 1.5 × distance between *la-lm*)..... .....*Ctenoppia variopectinata* Balogh & Mahunka, 1975

— Notogastral setae short (*e.g.* length of seta *la* less than 0.66 × distance between *la-lm*..... *Ctenoppia eupectinata* Balogh & Mahunka, 1975

3 — Six pairs of genital setae. Prodorsal quadrangular field undelineated except for four small convex protruberances along posterior margin. Notogastral seta *c*2 present, small (length more than 2 × diameter of alveolus)..... .....*Kokoppia dudichi* (Balogh, 1982)

— Four or five pairs of genital setae. Prodorsal quadrangular field usually partially delineated by translamellar line; if undelineated, then notogastral seta *c*2 represented only by alveolus.....4

4 — Four pairs of genital setae. Prodorsal quadrangular field delineated anteriorly (translamella) and laterally (lamella) by low crest, and posteriorly by faint, transverse line. Notogastral seta *c*2 present, small (length more than 2 × diameter of alveolus). .....*Brassoppia brassi* (Balogh, 1982)

— Four or five pairs of genital setae. Prodorsal quadrangular field delineated anteriorly (translamella) and anterolaterally (lamella) by lines, and posteriorly with alveolate protruberance between setae *j*2-*j*2. Notogastral seta *c*2 present as microseta (length less than 2 × diameter of alveolus) or represented only by alveolus.....5

5 — Five pairs of genital setae.....*Brachioppiella* (*Brachioppiella*) 6

— Four pairs of genital setae normal for a species. *Brachioppiella* (*Gressittoppia*).....7

6 — Notogastral seta *lm* posterior to *la*, distance apart subequal to distance between *lm-lp*. Sensillus caput slim (about 2 × breadth of stalk) with three or four cilia. Somal length, 425-440..... .*B.* (*B.*) *biseriata* (Balogh and Mahunka, 1975)

— Notogastral seta *lm* level with and adaxial to *la*, distance apart less than 0.5 x distance between *lm-lp*. Sensillus caput medium breadth (about 3 × breadth of stalk), usually with five cilia, varies from three to seven cilia. Somal length, 290-345. .....*B.* (*B.*) *paranasalis* sp. nov.

7 — Apodeme *apo*4 reaching backward beyond level of genital shield. Setae in epimeral file *b* ciliate. Interlamellar seta more than 0.5 × length of lamellar seta. Sensillus with five cilia. Tibia IV slim (greatest breadth about 0.25 × length), seta *av* ensiform, long (length more than 2 x breadth of tibia). Somal length, 360-520..... .....*B.* (*G.*) *magna* sp. nov.

— Apodeme *apo*4 reaching back only to middle of genital shield. Setae in epimeral file *b* smooth. Interlamellar seta less than 0.5 × length of lamellar seta. Sensillus with six or seven cilia. Tibia IV not slim (greatest breadth about 0.33 × length), seta *av* setose or ensiform, medium length (length subequal to breadth of tibia). Somal length less than 300.....8

8 — Notogastral seta *lm* nearer *lp* than *la*. No apodeme between *ep*2, epimeral *apo*2 not continuous across midline. Tibia IV with clearly delineated caput bearing setose ventral setae. Somal length, 185-220. .....*B.* (*G.*) *minima* sp. nov.

— Notogastral seta *lm* nearer *la* than *lp*. Apodeme between *ep*2, epimeral *apo*2 continuous across midline. Tibia IV with indistinct caput/stalk margin, bearing ensiform ventral setae. Somal length, 275-295..... .....*B.* (*G.*) *pseudohigginsi* sp. nov.

Genus ***Brachioppiella*** Hammer

Brachioppiella Hammer, 1962: p. 47.
Type-species (by original designation): *Brachioppiella periculosa* Hammer, 1962.

Diagnosis (Adults)

Brachioppiinae. Sensillus pectinate with single file of long cilia either on fusiform or setiform caput. Rostral setae separated by distance more than 4 × diameter of one of their alveoli. Interlamellar seta present. Lamellar seta closer to interlamellar seta than rostral seta. Rostrum not incised. Costula (but lamellar line may be present) and crista absent. Ten pairs notogastral setae, seta *c*2 vestigial (either microseta, length less than twice alveolus diameter, or just alveolus). Apodeme IV present. Four or five pairs of genital setae. Ventral seta *ad*1 postanal, *ad*3 preanal. Pore *iad* inverse apoanal. Tarsus IV with two ensiform anteroventral setae and two ciliate cuneiform posteroventral setae.

Morphology of Australian species

The prodorsum has a plateau-like quadrangular field around the lamellar and interlamellar setae. It is usually delineated (exception — *Brachioppiella biseriata* Balogh & Mahunka, 1975) anteriorly by a translamellar line (in lateral view can be seen to be a sulculus, which may be substantial but inconspicuous when seen from above, with edges that are recognisable as two parallel fine lines), whilst laterally it is bordered by a granulate slope which anteriorly forms a lamellar line (there are no costulate ridges), and posteriorly there is a protruberance between the interlamellar setae with alveolate sculpturing. There is a lateral row of large alveoli, and around the exobothridial seta the integument is granulate. The sensillus is not longer than the distance from its partner and the pectinate caput can be slim (as *Brachioppiella biseriata*, with width less than twice that of proximal stalk), broad or swollen. The notogaster shows little variation, except in setal length (large setae may have cilia and seta *c*2 may or may not be detectable) and in the position of seta *lm* relative to seta *la*. The venter has strong epimeral apodemes with weak superficial sculpturing forming shallow alveoli on the epimeres. The longer lateral epimeral setae may be ciliate. The most conspicuous varying characters are the number of genital setae, the position of apodeme IV and the presence or absence of an apodeme between epimeres 2. The size of the genital shields is sexually dimorphic, being larger on the female (Fig. 2) and smaller on the male (Fig. 8). No eggs were noted in any females collected in this study. Trochanter III has a transverse proximodorsal ridge with spurs at both ends. All the tibiae have a long flagelliform solenidium (*cf. Brachioppia cuscensis* Hammer, 1961, type-species, which has a short fat solenidium on tibia II). In all but the small *Brachioppiella minima* sp. nov., the tibiae and tarsi have stout, ensiform ventral spine-like setae, sometimes ciliate, whilst the two proximal shorter posterior spine-like setae on leg IV are ciliate cuneiform, the cilia being merged proximally and spreading out distally into an inverted triangle. Similar distal spreading out of ventral leg setae may be widespread amongst oppiids, and can involve more setae [*e.g. Brachioppiella* (*Gressittoppia*) *orkneyensis* (Kok, 1967) and *Quadroppia quadricarinata* (Michael): Lions 1977]. Somal chaetotaxy: prodorsum — 2, 2, 1; notogaster — 2, 6, 2; epimeres — 3, 1, 3, 3; genital shield — 4 or 5; anal shield — 2; ventral shield — 1, 3.

Distribution

All species of *Brachioppiella* are known only from the major southern regions, mainly in the temperate zone, with a few species from the tropics (see the remarks on the subgenus *Brachioppiella*), and the subantarctic or antarctic (see the remarks on the subgenus *Gressittoppia*).

Amongst the nine florally diverse sites sampled in South Australia, the greatest numbers of three of the four species of *Brachioppiella* were found at the dry sclerophyll forest site on Mt Lofty, which has the highest rainfall (mainly in winter, being a Mediterranean-type climate) of any site. One of these species, *B.* (*Gressittoppia*) *minima* sp. nov., also occurs in small numbers at two nearby sites in the Mt Lofty Ranges. The fourth species, *B.* (*Gressittoppia*) *pseudohigginsi* sp. nov., is from coastal closed-scrubland, which has a lower rainfall, but is a very moist site, since it is much further south and it is sometimes inundated from a permanent underground stream. The only other known Australian species, *B.* (*Brachioppiella*) *biseriata* (Balogh & Mahunka, 1975), is from dry sclerophyll forest in Queensland.

Remarks

Brachioppiella was placed by J. Balogh (1983) in the subfamily Pulchroppiinae. Later, Subias & P. Balogh (1989) considered that this subfamily should be restricted to *Pulchroppia* Hammer, 1979 and related genera, in which epimeres 3 and 4 are not bordered posteriorly by an apodeme, whilst *Brachioppiella* was the nominotype of a new subfamily. J. Balogh (1983) also established a heterogeneous subfamily, Cycloppiinae, giving considerable weight in the diagnosis to the number of pairs of genital setae. The genus *Gressittoppia* was grouped in Cycloppiinae, because of its four pairs of genital setae, whilst Subias and P. Balogh (1989) considered it to be so closely allied to *Brachioppiella* that it was given the new status of subgenus within that genus. As pointed out here, in the remarks on *B.* (*Gressittoppia*), the two genus group names might be better considered to be synonymous. The only distinguishing character that has been established for the subgenera is the normal number of genital setae. In the case of

Brachioppiella (*Gressittoppia*) *magna* sp. nov. (which on only one specimen has an increased setation from four to five genital pairs), characters are given in the remarks on the species, that distinguish the abnormal specimen from Australian members of the subgenus *Brachioppiella*.

Subgenus ***Brachioppiella (Brachioppiella)*** Hammer

Diagnosis (Adult)

Brachioppiella. Five pairs of genital setae.

Remarks

The subgenus *Brachioppiella* sens. str. is maintained as by Subias & P. Balogh (1989), delineated from *B.* (*Gressittoppia*) by having five pairs of genital setae. The possiblity that species of *Brachioppiella* should not be grouped into two subgenera is commented on in the 'Remarks' under *Brachioppiella* (*Gressittoppia*).

Brachioppiella (*Brachioppiella*) includes 10 species (Subias & P. Balogh 1989), plus a new species described here from South Australia. The subgenus is widespread in southern temperate regions with a few records from the tropics (New Caledonia, Guinea in West Africa, East Africa). The two Australian species are as follows: *Brachioppiella* (*Brachioppiella*) *biseriata* (Balogh & Mahunka, 1975) and *B.* (*B.*) *paranasalis* sp. nov..

Brachioppiella* (*Brachioppiella*) *paranasalis sp. nov.
(Figs 1, 2 and 9)

Morphology

General appearance and dimensions: Body flattened and widened, brown colour. Idiosomal length: female 320 (39, 308–344); male 309 (44, 290–328). Idiosomal breadth: female 133–143, male 122–135. Leg dimensions for holotype female (length 321): leg lengths (femur-tarsus) I–191, II–145, III–136, IV–180; tibial maximum breadths I–21.5, II–19, III–15.5, IV–15.5.

Prodorsum: Rostrum rounded, unstructured, with rostral setae dorsally ciliate. Quadrangular field with lamellar line restricted to anterior half of distance between lamellar seta and sensillus, whilst translamellar line may be inconspicuous, because although sulculus deep, margins may be unclear in dorsal aspect, and posterior protruberance narrow with two pairs of alveolar, pale patches. Usually three large alveolar, pale patches lateral to quadrangular field. Lamellar, exobothridial and interlamellar setae fine and smooth, decreasing in size in this order, lamellar seta nearly 2 × length of interlamellar seta. Granulated area around exobothridial seta not reaching profile of pedotectum I. Usually five long cilia on caput of sensillus, but varies from three to seven cilia, in single file.

Notogaster: Nine pairs of short to medium length smooth setae, *h*2 and *h*3 longest, seta *c*2 represented only by alveolus with root, but no seta, just behind pore *ia*. Seta *lm* close to and slightly anterior to seta *la*.

Somal venter: Epimeres with weak alveolar sculpturing. In setal file *b*, setae 3*b* and 4*b* like file *c*, but 1*b* similar to file *a* in being smooth and slimmer. Apodeme *apo4* reaching backward to level of mid genital shield. Pedotectum 1 profile smooth, no pedotectum 2, pedotectum 3 large and blunt. Genital setae short and subequal in length. Aggenital seta shorter (0.6 ×) than adanal seta *ad*3.

Legs: Long (mean femur-tarsus length: 50% of somal length). Legs I and IV longer than other legs, whilst legs I and II are stouter than other legs. Relative breaths of tibiae (maximum height: length): I = 56%, II = 57%, III = 43%, IV = 33%. Ventral setae on tibiae and tarsi often ensiform and ciliate. On tibia and tarsus IV, posteroventral setae shorter than anteroventral setae. Tarsus IV setae *pv*1 and *pv*2 with single file of cilia longer proximally so that terminating at same level giving seta a cuneiform appearance in posteroventral aspect.

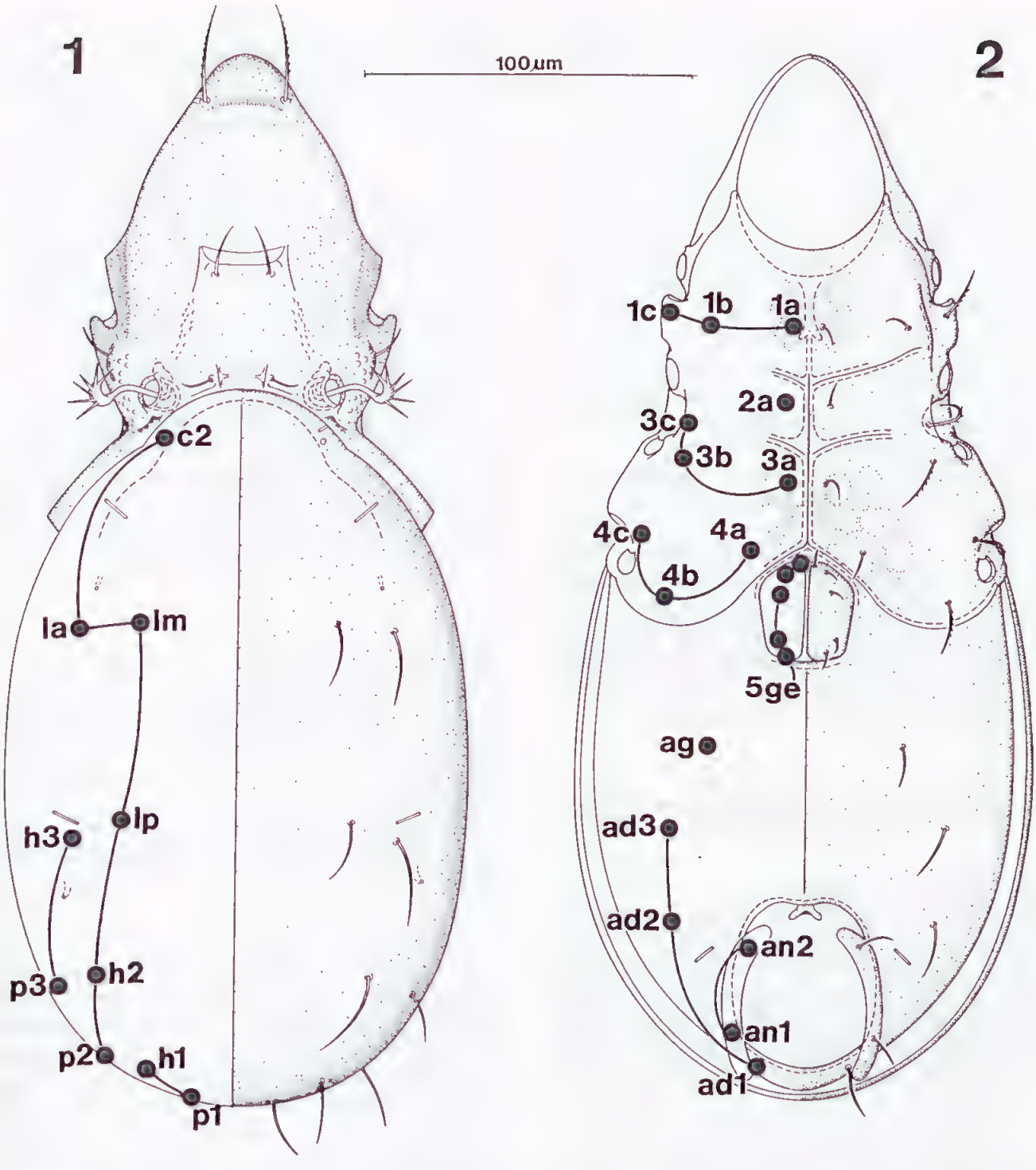
Material examined

Holotype: female (N1989277), plant litter, sparse moss and sandy soil, under sclerophyllous shrubs amongst messmate stringybark (*Eucalyptus obliqua*), dry sclerophyll forest, near summit of Mt Lofty (34°9′S, 138°5′E), Cleland Conservation Park, 9.v.1974.

Paratypes: 26 females (N1989278-N1989303) and 30 males (N1989304-N1989333); 2 females and 3 males (FBUCM); 2 females and 2 males (FMNH); 2 females and 2 males (NZAC); 6 females and 7 males lost; same data as holotype.

Remarks

Brachioppiella (*Brachioppiella*) *paranasalis* is easily distinguished from known Australian species of *Brachioppiella* by having notogastral seta *lm* transposed anteriorly to near *la*. This includes the other member of the subgenus and the larger *Brachioppiella* (*Gressittoppia*) *magna* sp. nov., which in only one of its females examined also has five pairs of genital setae rather than the normal four pairs for *Gressittoppia*. The shape of the sensillus and the nature of the lamella and translamella, in combination with the relative position of notogastral seta *lm* to *la*, distinguishes *B.* (*B.*) *paranasalis* from all known species of *Brachioppiella*, and the position of seta *lm* is only known elsewhere in Australian brachioppielline genera on *Brassoppia brassi* (Balogh, 1982). The



FIGURES 1 AND 2. *Brachioppiella* (*Brachioppiella*) *paranasalis* sp. nov., female soma. 1, notum; 2, idiosternum.

species which is most similar, and from which the species name is derived with the Greek prefix *para* meaning 'beside or new', is *Brachioppiella* (*B.*) *nasalis* (Evans, 1953), which has notogastral setae of similar length and placement. But that species has a sensillus with a slim, nearly setiform caput, with six lateral cilia, and also there are 'Anterior to the genital plate two forwardly directed projections on either side.' (Evans 1953: 260), as well as conspicuous granulation on the prodorsal quadrangular field.

Subgenus ***Brachioppiella* (*Gressittoppia*)** Balogh

Gressittoppia Balogh, 1983: p. 55.
Type-species (by original designation): *Brachioppia moresonensis* Kok, 1967.

Diagnosis (Adults)
Brachioppiella. Four pairs of genital setae.

Remarks
The subgenus *Brachioppiella* (*Gressittoppia*) was given this status by Subias & P. Balogh (1989), prior

to which *Gressittoppia* was regarded by J. Balogh (1983) as a distinct genus in another subfamily (Cycloppiinae) compared to *Brachioppiella*, then included in the Pulchroppiinae. The distinction between the subgenera relies on the number of genital setae and this character exhibits intraspecific variation in *B.* (*G.*) *magna* sp. nov. (only one female has five pairs of genital setae, rather than the usual four pairs). Because of this, and because no other character state can be found to diagnose the subgenus, *Gressittoppia* and *Brachioppiella* may need to be regarded as synonymous as subgenera as well as genera. The position of the fissure *iad* being given importance here in defining families, means that similar species to *Gressittoppia*, like *Gressittoppia luxtoni* Ayyildiz, 1989, are excluded to another subfamily (Multioppiinae).

Brachioppiella (*Gressittoppia*) includes seven species (Subias & P. Balogh 1989) plus a further three new species described here from South Australia, the first records of the subgenus from Australia. The subgenus is widespread in southern temperate regions, with a few records from the far south (Tierra del Fuego and Antarctica). The three Australian species are as follows: *Brachioppiella* (*Gressittoppia*) *magna* sp. nov., *B.*(*G.*) *minima* sp. nov. and *B.*(*G.*) *pseudohigginsi* sp. nov..

Brachioppiella* (*Gressittoppia*) *magna sp. nov.
(Figs 3, 4, and 10)

Morphology

General appearance and dimensions: Body flattened and widened, dark red brown colour. Idiosomal length: female 498 (5, 480–520); male 412 (3, 362–463). Idiosomal breadth: female 212–229, male 174–206. Leg dimensions for holotype female (length 501): leg lengths (femur-tarsus) I–292, II–238, III–247, IV–307; tibial maximum breadth I–31, II–25, III–19, IV–22.

Prodorsum: Rostrum rounded, pale above ventral recess, with rostral setae dorsally ciliate. Quadrangular field with lamellar line nearly complete, whilst translamellar line with clear anterior margin to deep sulculus but posterior margin may be unclear in dorsal aspect, and posterior protruberance narrow and conspicuous with three pairs of alveolar, pale patches. Usually four large alveolar, pale patches lateral to quadrangular field. Only exobothridial seta is smooth, lamellar seta about 1.5 × length of interlamellar seta. Granulate area round exobothridial seta reaching profile to pedotectum I. Usually five, exceptionally four or six long cilia on caput of sensillus.

Notogaster: Nine pairs of medium length setae, sometimes inconspicuous dorsal cilia present, *c*2 represented by microseta. Seta *lm* nearly directly behind *la* and slightly nearer to it than to seta *lp*.

Somal venter: Epimere with strong alveolar sculpturing. In setal file *b*, all setae similar to those in file *c*. Apodeme *apo*4 reaching backward beyond level of posterior margin of genital shield. Pedotectum 1 profile granulate, small pedotectum 2 present, pedotectum 3 large and acute. Usually four pairs of genital setae, but one female with five pairs of genital setae. Anterior three pairs of genital setae short, seta *ge*4 longer. Aggenital seta longer than or subequal in length to adanal seta *ad*3.

Legs: Long (mean femur-tarsus length = 54% of soma length). Legs III and IV slim and relatively long so that leg IV longest and leg III third longest rather than shortest. Relative breadths of tibiae (maximum height: length): I = 57%, II = 43%, III = 31%, IV = 28%. Ventral setae on tibiae and tarsi (except *av*4 and *pv*4 on tarsus IV) ensiform and ciliate. On tarsus IV posteroventral setae *pv*1 and *pv*2 with cilia enlarged and fused at base so that fan-like.

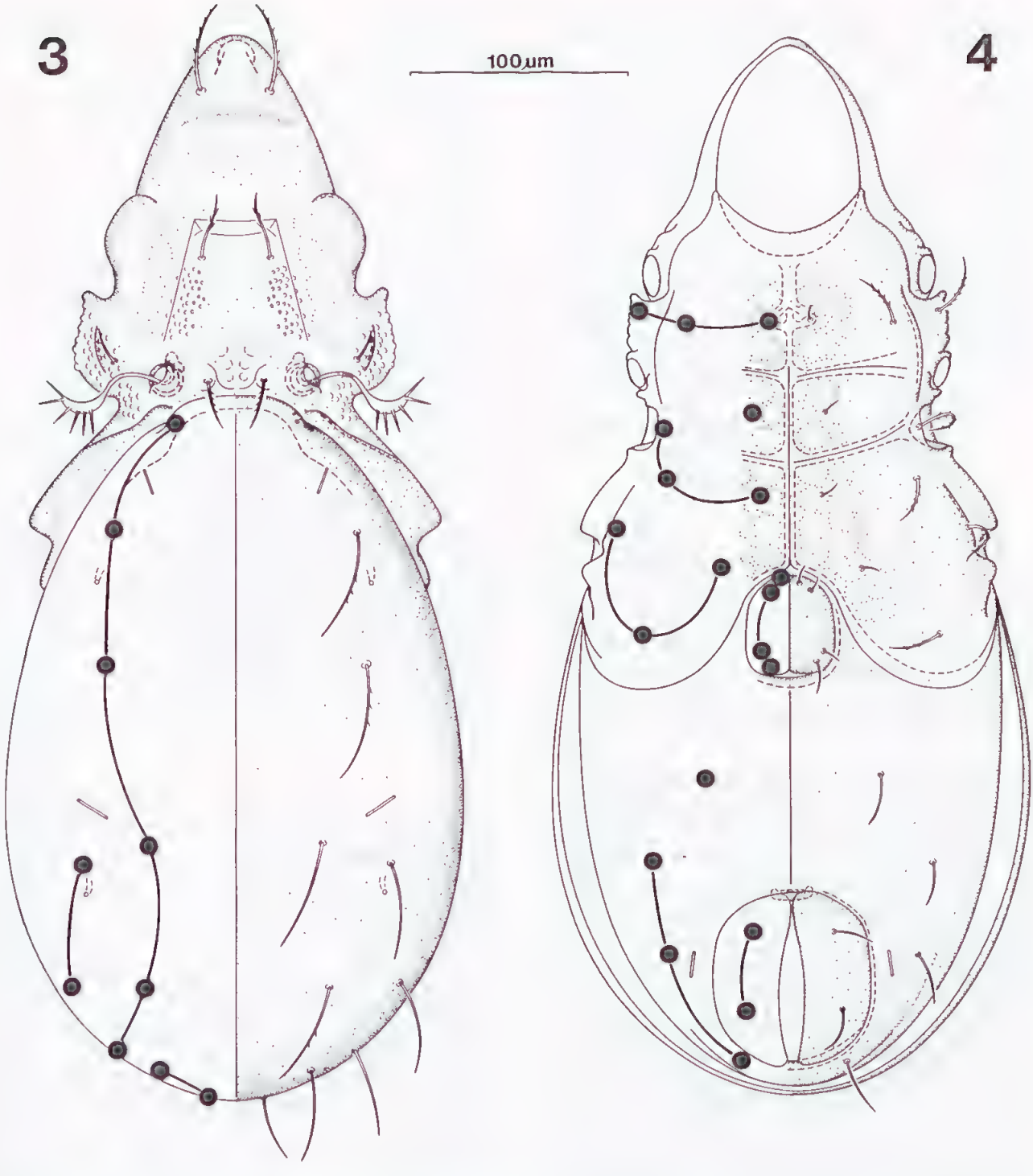
Material examined

Holotype: female (N1989334), plant litter, sparse moss and sandy soil, under sclerophyllous shrubs amongst messmate stringybark (*Eucalyptus obliqua*), dry sclerophyll forest, near summit of Mt Lofty (34°9′S, 138°5′E), Cleland Conservation Park, 9.v.1974.

Paratypes: 5 females (N1989335-N1989339) and 3 males (N1989340-N1989342); 1 female (FBUCM); same data as holotype.

Remarks

Brachioppiella (*Gressittoppia*) *magna* is variable in size, males being substantially smaller than females. The larger females are the largest within the genus, which is the basis of the species name derived from the Latin word *magnus* meaning 'large or great'. Possibly correlated with greater size are the dark colour, more extensive cuticular sculpturing and granulation, with more setae that are ciliate. *B.* (*G.*) *magna* is easily distinguished from other known Australian members of *Gressittoppia* by the backward extension of epimere 4 and the long leg IV, possibly functionally correlated character states. *B.* (*Brachioppiella*) *biseriata* (Balogh & Mahunka, 1975) from Queensland is large with a similarly extensive epimere 4 and disposition of the notogastral setae, so it may in the future be regarded as allied to this species, although they are currently in different subgenera. This possibility is more likely in the light of one female of *B.* (*G.*) *magna* having five pairs of genital setae, the extra pair making the disposition very similar to that of *B.* (*B.*) *biseriata*. But *B.* (*B.*) *biseriata* is further distinguishable as a separate species by



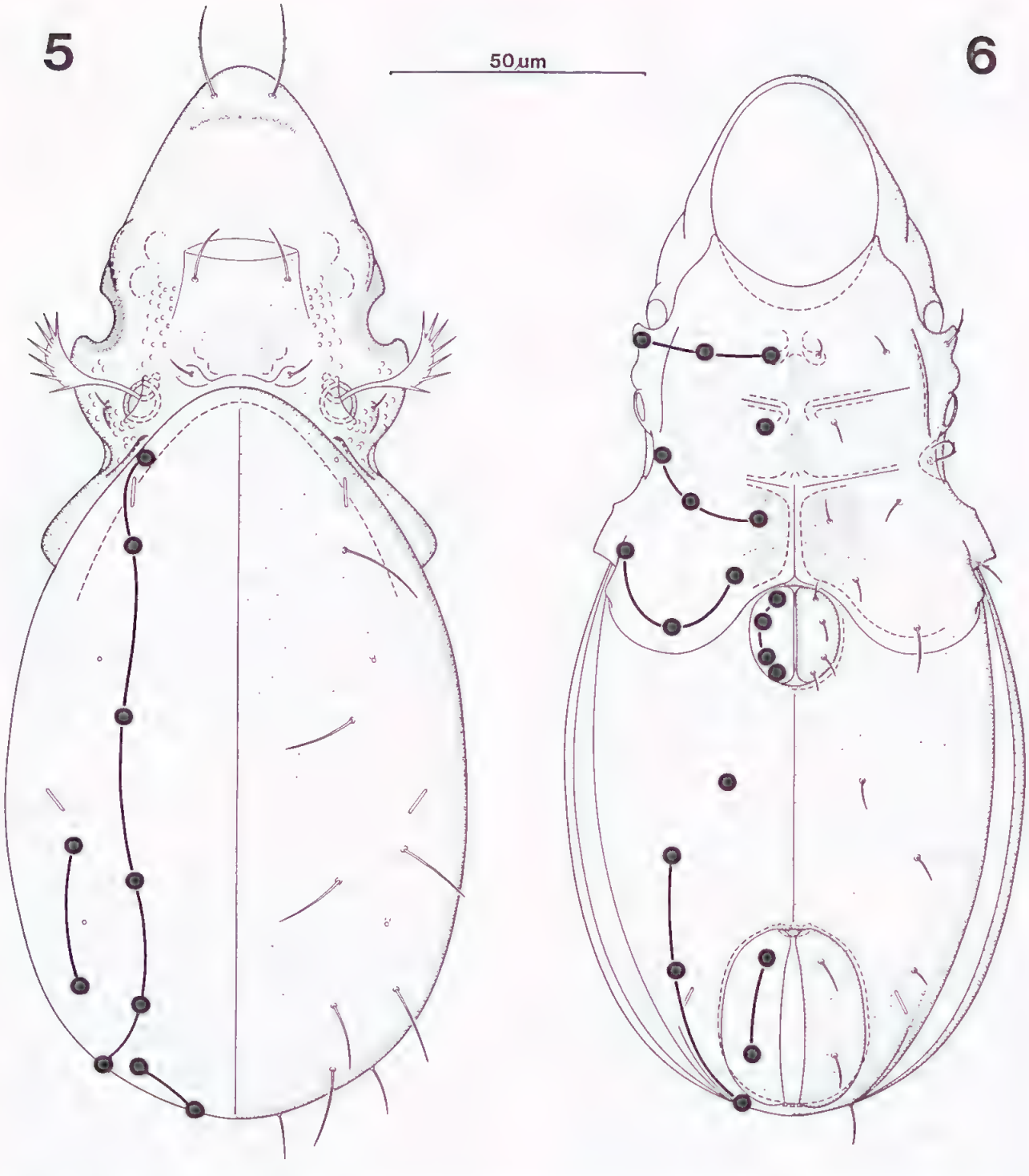
FIGURES 3 AND 4. *Brachioppiella* (*Gressittoppia*) *magna* sp. nov., female soma. 3, notum; 4, idiosternum.

having a number of shorter setae, in particular the interlamellar and aggenital setae and a slim caput to the sensillus. *B.* (*G.*) *magna* is also similar to *B.* (*G.*) *hartensteini* (Hammer, 1968), but the latter has a small seta *c*2 present, the caput of the sensillus is slimmer and notogastral seta *h*3 is anterior to pore *im*.

Brachioppiella* (*Gressittoppia*) *minima sp. nov.
(Figs 5, 6 and 11)

Morphology

General appearance and dimensions: Body flattened and widened, straw colour. Idiosomal length: female 208 (28, sclerophyll forest, 200–217),



FIGURES 5 AND 6. *Brachioppiella* (*Gressittoppia*) *minima* sp. nov., female soma. 5, notum; 6, idiosternum.

200.5 (1, pine forest); male 198 (74, sclerophyll forest, 185–206), 192 (2, pine forest, 185–200.5), 190 (1, savannah woodland). Idiosomal breadth: female 78–87, male 85–95. Leg dimensions for holotype female (length 205.5): leg lengths (femur-tarsus) I–119, II–89, III–89, IV–98; tibial maximum breadths I–14.5, II–12, III–11, IV–12.

Prodorsum: Rostrum rounded, unstructured, with rostral setae dorsally ciliate. Quadrangular field with lamellar line restricted to anterior half of distance between lamellar seta and sensillus, translamellar line inconspicuous, sulculus shallow, margins may be unclear in dorsal aspect, posterior protruberance broad, flattened with two pairs of alveolar, pale patches. Usually two large alveolar pale patches lateral to quadrangular field. Lamellar, interlamellar and exobothridial setae fine and smooth, decreasing in size in this order, lamellar seta nearly 2 × length of interlamellar seta. Granulate area around exobothridial seta not

reaching profile of pedotectum I. Usually six long cilia on caput of sensillus, may be additional one or two smaller proximal cilia.

Notogaster: Nine pairs of medium length smooth setae, subequal in length, seta *c*2 only represented by alveolus with root, but no seta. Seta *lm* nearly directly behind *la* and midway between it and seta *lp*.

Somal venter: Epimeres with weak alveolar sculpturing. In setal file *b*, setae 1*b* and 3*b* like file *a*, whilst 4*b* is as long as setae in file *c*, but smooth, without cilia. Apodemes absent between epimeres 1 and 2, although linear surface sculpturing present. Pedotectum 1 profile smooth, no pedotectum 2, pedotectum 3 large with acute point. Genital setae short and subequal in length. Aggenital seta subequal in length to adanal seta *ad*3.

Legs: Medium length (mean femur-tarsus length = 48% of somal length). Legs I and IV longer than other legs, leg II being as short as leg III, but as broad as leg IV. Relative breadths of tibiae (maximum height: length): I = 57%, II = 66%, III = 45%, IV = 48%. Tibia IV shorter than tarsus IV, caput broad, more than 2.5 × breadth of stalk. Ventral setae on tarsi II-IV often ensiform and ciliate, but not on tibiae. On tibia IV, seta *av* longer and stouter than *pv*, but still setose and similar to *d*2 on tarsus IV.

Material examined

Holotype: female (N1989343) plant litter, sparse moss and sandy soil, under sclerophyllous shrubs amongst messmate stringybark (*Eucalyptus obliqua*), dry sclerophyll forest, near summit of Mt Lofty (34°9′S, 138°5′E), Cleland Conservation Park, 9.v.1974.

Paratypes: 19 females (N1989344-N1989362) and 66 males (N1989363-N1989428); 2 females and 2 males (FBUCM); 2 females and 2 males (FMNH); 2 females and 2 males (NZAC); same data as holotype. One female (N1989429) and two males (N1989430, N1989431), pine litter and sandy soil, under pine trees (*Pinus pinea*), cultivated forest, Knott Hill (35°12′S, 138°41′E), Kuitpo Forest Reserve, 22.v.1974. One male (N1989432), grass, moss, leaf litter and loamy soil under manna gum trees (*Eucalyptus viminalis*), savannah woodland, Chambers Gully (34°59′S, 138°41′E), Cleland Conservation Park, 12.vi.1974.

Remarks

Brachioppiella (*Gressittoppia*) *minima* is the smallest known species in the genus, which is the basis of the species name derived from the Latin word *minimus* meaning 'least'. It is similar to *Brachioppiella* (*Gressittoppia*) *pepitensis* (Hammer, 1962), a slightly larger species (length 270) from Tierra del Fuego. *B.* (*G.*) *pepitensis* differs in minor ways in the disposition and shape of setae as follows: sensillus with nine or ten cilia, hysteronotal seta *la* closer to *lm* than *c*2, adanal seta *ad*2 posterior to pore *iad*. Although some cuticular markings are stronger, the apodeme between epimeres 1 is absent posterior to seta 1*a*, suggesting a close relationship of *B.* (*G.*) *pepitensis* to *B.* (*G.*) *minima*, even though the shape of its tibia and tarsus IV is normal for the genus (similar to *B.* (*G*). *pseudohigginsi* sp. nov., Fig. 12) and unlike that of *B.* (*G.*) *minima* (Fig. 11). The correlation of the reduction in mid-sternal apodemes and the shape of the leg segments and their ventral setae characterizes *B.* (*G.*) *minima*.

Brachioppiella* (*Gressittoppia*) *pseudohigginsi sp. nov.
(Figs 7, 8 and 12)

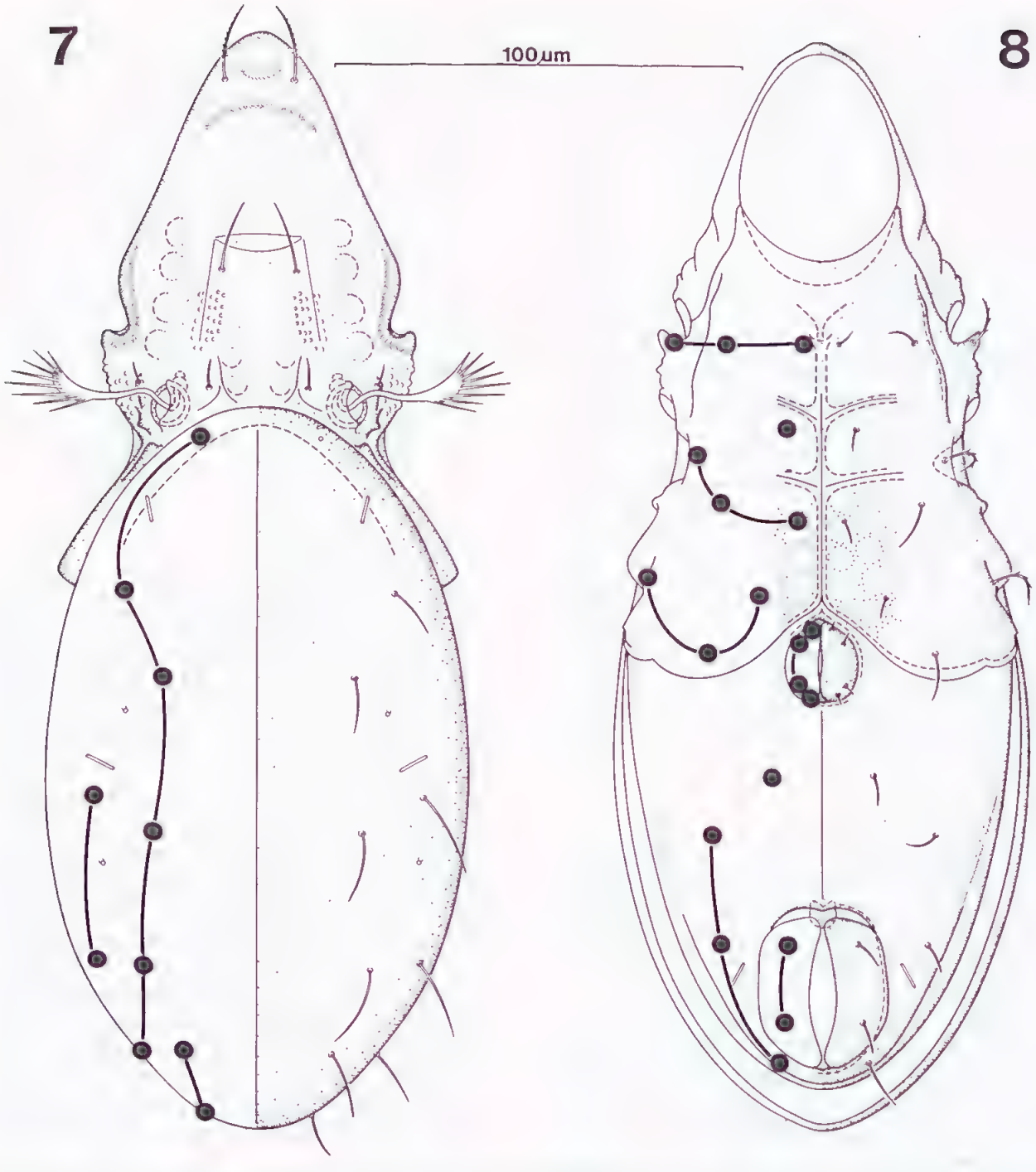
Morphology

General appearance and dimensions: Body flattened, broad for female, elongate for male, brown colour. Idiosomal length: female 295, male 275. Idiosomal breadth: female 117, male 112. Leg measurements for holotype male (length 275): leg lengths (femur-tarsus) I–156, II–118, III–109, IV–139; tibial maximum breadths I–18, II–14.5, III–12, IV–12.

Prodorsum: Rostrum round, unstructured except slight concavity between dorsally ciliate rostral setae. Quadrangular field with lamellar line nearly complete, translamellar line with moderately deep sulculus, but margins may be unclear in dorsal aspect, and posterior protruberance broad with two pairs of alveolar pale patches. Four large alveolar, pale patches lateral to quadrangular field. Lamellar, interlamellar and exobothridial setae fine and smooth, decreasing in size in this order, lamellar setae more than 2 × length of other setae. Granulate area around exobothridial seta reaching profile of pedotectum I. Six or seven long cilia on caput of sensillus.

Notogaster: Nine pairs of short to medium length smooth setae, *la* and *lm* being short, seta *c*2 represented only by alveolus with root, but no seta, just behind pore *ia*. Seta *lm* behind and closer to seta *la* than to *lp*.

Somal venter: Epimeres with weak alveolar sculpturing. In setal file *b*, seta 1*b* shorter than 1*c*, whilst 3*b* and 4*b* similar in length to 3*c* and 4*c*, but all smooth lacking cilia. Apodeme *apo*4 reaching backward to level of mid-genital shield. Pedotectum 1 profile granulate, no pedotectum 2, pedotectum 3 large and blunt. Genital setae short and subequal in length (*N.B.* male illustrated, Fig. 8, so plates appear relatively small compared to other species where females illustrated). Aggenital seta subequal in length to adanal seta *ad*3.



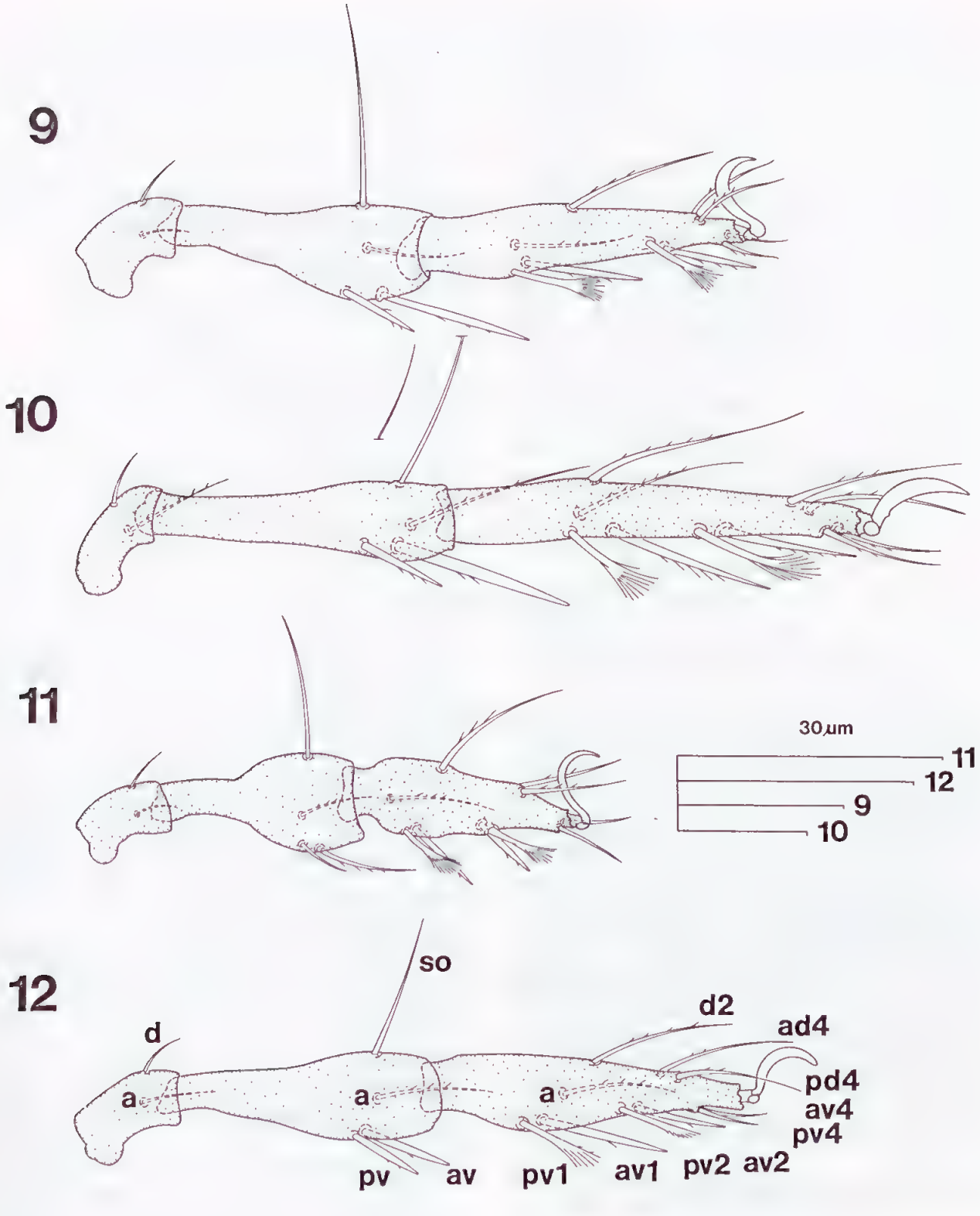
FIGURES 7 AND 8. *Brachioppiella* (*Gressittoppia*) *pseudohigginsi* sp. nov., male soma. 7, notum; 8, idiosternum.

Legs: Medium length (mean femur-tarsus length = 47% of somal length). Legs I and IV longer than other legs, whilst legs I and II are stouter than other legs. Relative breadths of tibiae (maximum height: length): I = 54%, II = 55%, III = 45%, IV = 33%. Tibia IV shorter than tarsus IV, caput medium breadth, slightly less than 2 × breadth of stalk. Ventral setae on tibiae and tarsi often ensiform and ciliate. On tibia IV, ventral seta *av* only slightly longer than *pv* and shorter than *av*1 on tarsus IV.

Material examined

Holotype: male (N1989433), plant litter, sparse grass and calcareous sandy soil, under coastal wattle (*Acacia sophorae*), coastal closed scrubland, just south of main pond (38°03′S, 150°57′E), Piccaninnie Ponds Conservation Park, 3.vii.1974.

Paratype: female (N1989434); same data as holotype.



FIGURES 9–12. *Brachioppiella*, posterior aspects of genu, tibia, tarsus, pretarsus of right leg IV. 9, *B.* (*B.*) *paranasalis* sp. nov.; 10, *B.* (*G.*) *magna* sp. nov.; 11, *B.* (*G.*) *minima* sp. nov.; 12, *B.* (*G.*) *pseudohigginsi* sp. nov. Key: a = anterior, d = dorsal, p = posterior, v = ventral, so = solenidium.

Remarks

Brachioppiella (*Gressittoppia*) *pseudohigginsi* is very similar to *Brachioppiella* (*Brachioppiella*) *higginsi* (Hammer, 1968) from New Zealand in the disposition and shape of the notal setae, which is the basis of the species name derived from the Greek word *pseudos*, meaning 'lie', and *higginsi*. *B.* (*B.*) *higginsi* has a slimmer caput to its sensillus and has five pairs of genital setae, which places it in the nominate subgenus. *B.* (*G.*) *pseudohigginsi* is also similar to two larger species from South Africa: *B.* (*G.*) *moresonensis* (Kok, 1967), length 300-344, and *B.* (*G.*) *orkneyensis* (Kok, 1967), length 330-380. *B.* (*G.*) *moresonensis* differs in that notogastral seta *h*3 is positioned well forward, anterior to fissure-like pore *im* rather than posterior to it (Fig. 7). *B.* (*G.*) *orkneyensis* differs in that seta *av* on tibia IV is twice as long as seta *pv* and acutely tapered rather than shorter and stouter (Fig. 12).

RESUMEN

Como parte del estudio de los ácaros oribátidos de suelos del sur de Australia, se discute el género *Brachioppiella* Hammer, 1962, y se describen las cuatro nuevas especies siguientes: *Brachioppiella* (s. str.) *paranasalis* sp. nov., *Brachioppiella* (*Gressittoppia*) *magna* sp. nov., *B.* (*G.*) *minima* sp. nov. y *B.* (*G.*) *pseudohigginsi* sp. nov.. También se discute la subfamilia Brachioppiinae Subias, 1989 y se dan unas claves de géneros, subgéneros y especies australianos.

ACKNOWLEDGMENTS

We wish to thank Miss Keren Shepherd for the modifying, inking in and presentation of the figures, and the Australian Biological Resources Study for funding her salary. Also the translation from Spanish to English of parts of the manuscript and correspondence by Mrs Bobbie Matthews, and the typing of the manuscript by Mrs Debbie Lowery, are much appreciated.

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REDESCRIPTION OF THE LARVA OF *ODONTACARUS (LEOGONIUS) BARRINENSIS* (WOMERSLEY) (ACARINA: TROMBICULIDAE: LEEUWENHOEKIINAE)

R. V. SOUTHCOTT

SOUTHCOTT, R. V. 1991. Redescription of the larva of *Odontacarus (Leogonius) barrinesis* (Womersley) (Acarina: Trombiculidae: Leeuwenhoekiinae). *Rec. S. Aust. Mus.* 25(1): 31–37.

The larva of *Odontacarus (Leogonius) barrinensis* (Womersley, 1945) is redescribed, the lectotype and paralectotypes are designated, and the new data are compared with those of the original description. Womersley's measurements were too large (mean error = 3.53%). Analysis of the metric data confirms the separation of *O. (L.) barrinensis* from its taxonomically nearest species, *O. (L.) athertonensis* (Womersley, 1945).

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The genus *Odontacarus* Ewing, 1929 (Acarina: Trombiculidae: Leeuwenhoekiinae) is known mainly as larvae in the Australia-New Guinea region; all of these are placed in the subgenus *Leogonius* Vercammen-Grandjean, 1968 (see Southcott 1986a).

The first Australian species recognized was *O. australiensis* (Hirst, 1925), a widespread species occurring from eastern Australia to New Guinea (Hirst 1925; Womersley 1944, 1945; Domrow 1956; Goff 1979a). Womersley (1944) described five more species as larvae (as *Leeuwenhoekia* Oudemans, 1911): *O. adelaideae, O. hirsti, O. mccullochi, O. novaguinea* and *O. southcotti,* and (1945) four more as larvae: *O. athertonensis, O. barrinensis, O. echidnus* and *O. longipes* (as *Acomatacarus* Ewing, 1942).

Further species (as larvae) have been added by Southcott (1957, 1986a, b) and Goff (1979a, b). The most recent general treatments of the taxonomy of these larvae have been by Southcott (1986a, b, 1989). Of the species known as larvae, deutonymphs have been described by Womersley (1945) of *O. longipes* and *O. novaguinea*, by Domrow (1956) of *O. australiensis*, and by Southcott (1989) of *O. adelaideae.* Based on larval characters, Domrow (1956) synonymized *O. hirsti* with *O. australiensis*, and Goff (1979a) synonymized *O. longipes* with *O. novaguinea.*

Womersley (1944, 1945) relied heavily on statistical characters for his species differentiations. Difficulties in separating some of these species led Veitch and Southcott (1984) to make a study of some species referred to *O. athertonensis*, or from the Atherton Tableland, Queensland. This showed good statistical differentiating characters for *O. athertonensis* (Womersley, 1945), *O. mccullochi* (Womersley, 1944), *O.* 'species S' (now *O. swani* Southcott, 1986a), and an unnamed species (now *O. veitchi* Southcott, 1986b) from Mt Jukes, Queensland.

One species requiring redescription was *O. (L.) barrinensis* (Womersley, 1945), which Womersley placed close to *O. athertonensis.*

In the present paper the larva of *O. (L.) barrinensis* is redescribed from the type series, and its taxonomic status evaluated.

Materials and Methods

Slide-mounted mites in the South Australian Museum, Adelaide (SAM) referred to *O. Barrinensis* were examined. The five syntypes (ACB188A-E) were all in gum chloral media, on individual slides, mounted by me on 17.xi.1943 and again on 7.v.1944, but apparently not remounted subsequently. Specimen ACB210A (N19896) showed evidence of remounting, and the mount was largely opaque and unusable. All these slides also bore a SAM number of ARA7524. No further remountings have been done.

Microscopy and drawing techniques, also terminology and abbreviations, are as in Southcott (1989). All measurements are in micrometres (μm) unless otherwise specified.

Odontacarus Ewing

Odontacarus Ewing, 1929, p. 188.
(For other synonymy see Southcott, 1986a, p. 171, and contained references).
Definition of larva as in Southcott, 1989, p. 37.
Type species: *Trombicula dentata* Ewing, 1925, p. 257.

Subgenus *Leogonius* Vercammen-Grandjean, 1968.
Definition of larva as in Goff, 1979a, p. 143.
Type species: *Leeuwenhoekia australiensis* Hirst, 1925, p. 150.

Odontacarus barrinensis (Womersley)
Figs 1A–D, 2

Acomatacarus barrinensis Womersley, 1945, p. 106. For other synonymy see Southcott, 1986a, p. 188.

Description of larva: Lectotype

Colour in life red. Length of idiosoma (mounted on slide) 245, width 200; total length from tip of cheliceral fangs to posterior pole of idiosoma 335.

Dorsal scutum wider than long (nasus included); nasus well developed, blunt pointed, slightly waisted, meeting body of scutum at approximately right angles; anterior border (omitting nasus) slightly concave, anterolateral borders convex, posterolateral borders almost straight, anterolateral and posterolateral angles rounded, posterior pole rounded, forming an obtuse angle. Scutalae narrow,

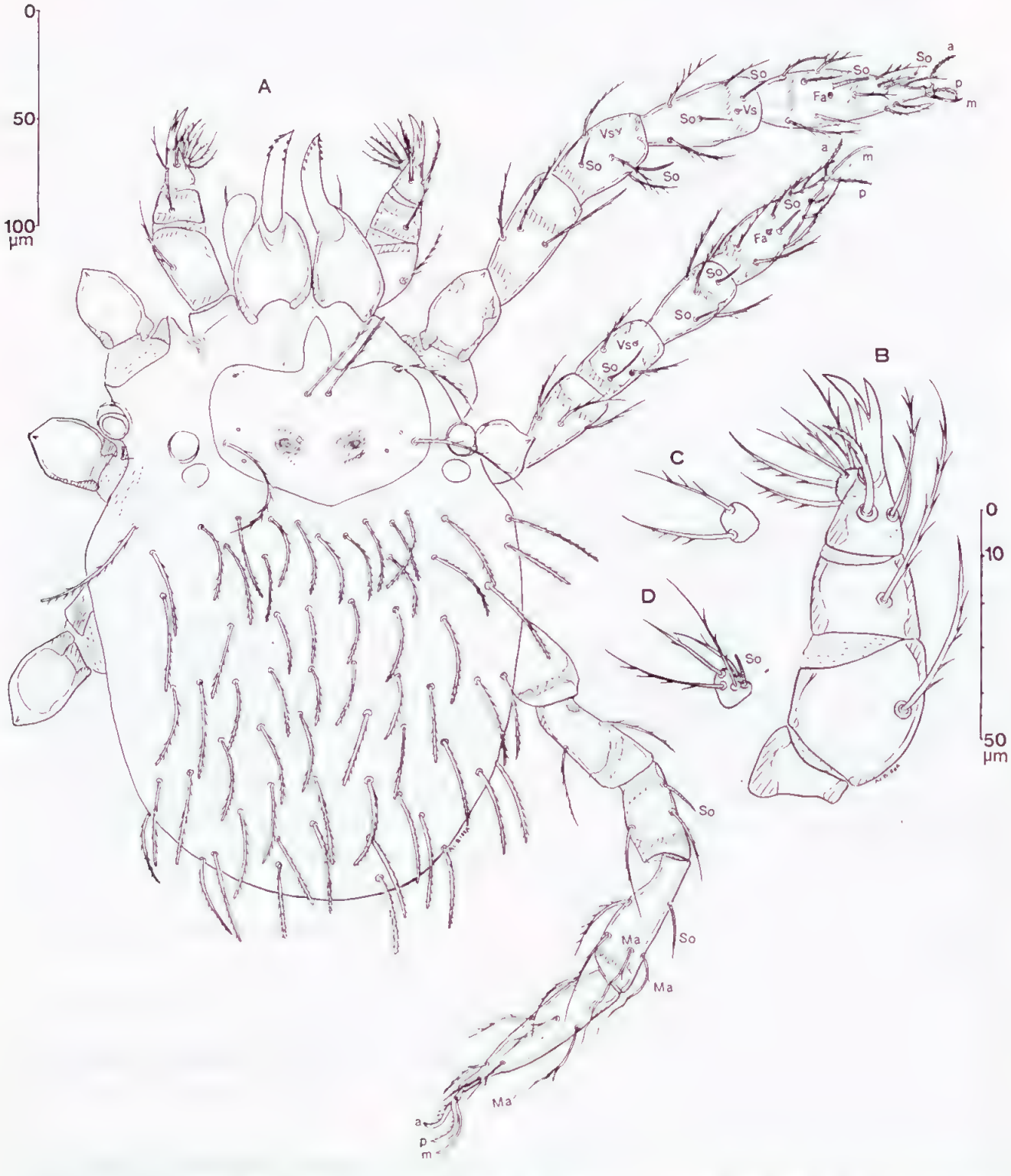

FIGURE 1. *Odontacarus barrinensis* (Womersley), larva, lectotype. A — Dorsal view, legs on left omitted beyond trochanters. B — Right palp, dorsal. C — Palpal tarsus, dorsal. D — Palpal tarsus, ventral. To standard symbols. (Each figure to nearer scale).

tapering, slightly blunted at tip, with moderately outstanding acute setules. Sensilla level with PL scutala bases; sensillary setae missing in all specimens. Scutum finely porose, with two larger pores (lacunae) near each PL scutala base.

Metric data as in Table 1.

Eyes oval, posterolateral to dorsal scutum, anterior with maximum diameter 16, posterior with maximum diameter 13.

Dorsal idiosomalae similar to scutalae, arranged: humerals 2, then approximately 18, 6, 10, 11, 9, 3, 2; total *ca* 61.

Ventral surface of idiosoma with a pair of setulose, pointed setae, bases 36 apart, between coxae III, 31 long. Behind coxae III opisthosoma with *ca* 46 setae, 28 pre-anal, 18 post-anal, pointed, setulose, 22–45 long, increasing in size posteriorad, and there resembling PDS. Anus oval, 21 long by 6 wide (valves apposed). Urstigma well chitinized, oval, 20 by 18, set in concavity in coxa I. Coxalae 2, 1, 1, well setulose, tapering, pointed; lateral coxala I 60 long, medial coxala I missing, all specimens, coxala II 44–46 long (paratypes), coxala III *ca* 42 long (paratypes).

TABLE 1. Metric data for *Odontacarus (Leogonius) barrinensis* (Womersley) larvae, type series.

Character	N19891 (ACB188A) Lectotype	n	Observed range	mean	s.d.	Coefficient of variation (%)
AW	73	5	68–73	69.6	2.07	2.98
PW	86	5	80–86	83.6	2.61	3.12
SB	31	5	26–31	28.0	2.00	7.14
ASB	55	5	52–55	54.0	1.41	2.62
PSB	27	5	26–28	27.0	1.00	3.70
L	82	5	78–83	81.0	1.87	2.31
LA	21	5	16–21	18.2	1.92	10.57
LB	61	5	61–64	62.8	1.30	2.08
LN	32	5	29–32	30.8	1.64	5.33
W	101	5	95–101	98.2	2.28	2.32
AP	31	5	27–32	30.0	1.87	6.24
AM	39	5	35–39	37.6	1.67	4.45
AL	46	5	40–46	43.2	2.68	6.21
PL	57	4	57–59	58.3	0.957	1.64
PL/AL	1.24	4	1.23–1.40	1.28	0.0818	6.40
AMB	11	5	11–12	11.4	0.548	4.80
Sens	–	0	–	–	–	–
PW/LB	1.41	5	1.28–1.41	1.33	0.0515	3.87
DS	33–60	5	57–64*	60.4*	2.70*	4.47*
Hum**	60	5	57–64	60.4	2.70	4.47
MDS	33–36	5	33–36*	35.0*	1.41*	4.04*
PDS	41–46	5	43–46*	45.2*	1.30*	2.88*
GeI	48	5	46–48	46.8	1.10	2.34
TiI	56	4	55–56	55.8	0.500	0.897
TaI(L)	80	5	79–89	84.4	4.62	5.47
TaI(H)	26	5	24–26	25.4	0.894	3.52
GeII	39	5	39–43	41.2	1.64	3.99
TiII	45	5	45–49	47.0	1.87	3.98
TaII(L)	66	5	66–72	70.2	2.68	3.82
TaII(H)	24	5	22–24	22.8	0.837	3.67
GeIII	47	5	46–48	47.0	0.707	1.50
TiIII	66	5	60–66	62.0	2.35	3.78
TaIII(L)	90	5	88–91	89.8	1.30	1.45
TaIII(H)	22	5	20–22	21.0	1.00	4.76
AW/AP	2.35	5	2.13–2.56	2.33	0.156	6.69
AW/TiIII	1.11	5	1.10–1.15	1.12	0.0241	2.14
PW/TiIII	1.30	5	1.30–1.41	1.35	0.0455	3.38
PSB/SB	0.87	5	0.87–1.08	0.968	0.0746	7.71
PW/AP	2.77	5	2.63–2.96	2.79	0.127	4.56

*For maximum values
**Humeral seta length

FIGURE 2. *Odontacarus barrinensis* (Womersley), larva, lectotype, ventral view, legs on left omitted beyond trochanters. Pt — pretarsala. (Some setae completed from paratypes).

Dorsal tracheal opening normal, between lateral border of palpal coxa and anterior border of coxa I.

Legs: lengths (including coxae and claws) I 370, II 330, III 390. Scobalar formula: trochanters 1, 1, 1, femora 6, 5, 4, genua 5, 4, 4, tibiae 7, 6, 6 (including 2 mastalae on III), tarsi 24, 17, 14 (including one mastala on III).

Leg specialized setae as follows (lengths in parentheses): SoGeI.30d(14), SoGeI.64p(21), VsGeI.65d(2), SoTiI.49d(16), VsTiI.77pd(3), SoTiI.89d(17) (*i.e.* distal to VsTiI). SoGeII.20d(18), VsGeII.60d(*cal*), SoTiII.40d(12), SoTiII.86d(14). SoGeIII.23d(26), SoTiIII.37d(24).

Tarsus I with SoTaI.49d(19), FaTaI.42pd(*ca*2). Tarsus II with SoTaII.54d(14), FaTaII.47d(*ca*2).

Pretarsal formula 1, 1, 0. Tarsal claws normal; neomedian the longest, thinnest; anterior and posterior claws with double fringes of small onychotrichs.

Gnathosoma normal; combined chelicera bases 68 across; length 89 from tip of cheliceral fangs to posterior margin chelicera bases. Fangs stout, curved, with 3–4 stout dorsal teeth and 4–5 smaller ventral teeth. Galeala simple, pointed, 22 long. Gnathobasal setae (palpal coxal setae) (from paratype ACB188C) slender, well setulose, 18 long, with four or five setules.

Material examined

Queensland: Lake Barrine, 16.xi.1943, R. V. Southcott, five larvae, N19891–19895 (ACB188A-E). *O. barrinensis* was based on 'five syn-types collected free, from Lake Barrine, Queensland, 16 Nov. 1943 (R.V.S.), and a single specimen from man, Atherton Tableland, Queensland, 8 March 1944 (R.V.S.)'. Southcott *(loc. cit.)* clarified collection details of these specimens. Specimen N19891 (ACB188A) is hereby specified as lectotype, specimens N19892–19895 (ACB188B-E respectively) paralectotypes.

The lectotype is labelled: R. H. label (in writing of R.V.S.): LECTOTYPE; (in writing of H. Womersley) *Acomatacarus barrinensis* n. sp./ Co-type/ Lake Barrine/ Q. 16.11.43/R.V.S./. L. H. Label (in writing of R.V.S.) ACB188A/ Running over log./ Shores of Lake Barrine/ Q. 16-11-1943/ R. V. Southcott. On reverse of slide, in unidentified writing: ARA7524/ Trombiculidae/ *Odontacarus/ barrinensis/* syntype.

Specimen N19896 (ACB210A) was unidentifiable (see above), and is excluded.

Remarks

The measurements given in Table 1 differ from those of Womersley (1945) for the same series of five mites. A comparison of Womersley's figures (means) for the same characters as used here shows that his measurements are higher than those given here. These eight percentage increases have a range of 0.67–6.38%, with a mean of 3.53 and a standard deviation of 1.86.

Successive efforts have been made to find differentiating characters for the larval *Odontacarus* of northern Queensland and Papua-New Guinea (Womersley 1944, 1945; Southcott 1957, 1986a, b, 1989; Goff 1979a, b, 1981; Veitch and Southcott 1984). Womersley's material has been only partly restudied, so that his differentiating characters as published had perforce to be utilized in my keys (1986a: 179; 1989: 42). Prominent among Womersley's criteria were the number of dorsal and ventral idiosomal setae, the ratio PW/LB (as 'PW/SD'), and the absolute sizes of the shield characters, as well as the length of DS. Clarification of the taxonomy of several species — *O. australiensis, O. novaguinea* and *O. hirsti* — was by Domrow and Goff. Veitch and Southcott (1984) and Southcott (1986a) provided adequate differentiating characters for *O. athertonensis, O. mccullochi, O. swani* and *O. veitchi.* The inconsistent errors in Womersley's measurements made the use of his key hazardous. Two species still needing differentiation were *O. athertonensis* and *O. barrinensis,* which had been collected from two sites on the Atherton Tableland, separated by about 22 km.

Womersley (1945: 106) stated of *O. barrinensis:* 'This species is very close to *athertonensis* in the number of dorsal setae, *ca* 64 in each. It differs, however, in the Standard Data, the values for AW, PW and SB being very significantly different.'

TABLE 2. Differentiating characters of the type series of *Odontacarus barrinensis* and *O. athertonensis* larvae.

	O. barrinensis					*O. athertonensis**				
Character	Lectotype	n	mean	s.d.	Observed range	Lectotype	n	mean	s.d.	Observed range
AW	73	5	69.6	2.07	68–73	71	21	65.9	2.70	61–71
PW	86	5	83.6	2.61	80–86	80	21	77.62	2.66	75–87
SB	31	5	28.0	2.00	26–31	25	21	25.10	1.41	22–30
PL/AL	1.24	4	1.28	0.0818	1.23–1.40	1.34	20	1.36	0.0805	1.20–1.57
PW/LB**	1.41	5	1.33	0.0515	1.28–1.41	1.21	21	1.25	0.0756	1.17–1.45
AW/AP	2.35	5	2.33	0.156	2.13–2.56	2.84	21	2.34	0.201	2.06–2.84
AW/TiIII	1.11	5	1.12	0.0241	1.10–1.15	1.09	21	1.10	0.0491	1.00–1.23
PW/TiIII	1.30	5	1.35	0.0455	1.30–1.41	1.23	21	1.30	0.0691	1.17–1.53
PSB/SB	0.87	5	0.968	0.0746	0.87–1.08	1.40	21	1.16	0.124	0.93–1.40
PW/AP	2.77	5	2.79	0.127	2.63–2.96	3.20	21	2.76	0.222	2.38–3.22

*From Southcott (1986a), plus new data
**PW/SD of Womersley (1945)

In Table 2 a comparison is given of metric characters of the type series of *O. barrinensis* and *O. athertonensis*. These are the principal characters used in keys to larvae. Table 2 shows that there is a considerable overlap of all the listed characters of the two species, and in fact the ranges of values for *O. barrinensis* lie entirely within those of *O. athertonensis*, for all characters except AW, SB and PSB/SB.

Table 3 shows a comparison of the means of the characters listed in Table 2, by t-test, on the usual assumption that the variances do not differ. Table 3 shows that there are significant differences between the 'size factors' AW, PW and SB. It shows also that there are significant differences in the 'shape factors', the proportions PW/LB and PSB/SB, and borderline significance for PL/AL. Comparison of the two type series has not revealed other morphological differences.

Even though exclusive separating characters between *O. athertonensis* and *O. barrinensis* larvae have not been found, the metric differences for scutal size and shape indicate that the separation is justified.

The life history of this species will be described in a succeeding paper.

TABLE 3. Comparison of means of key characters separating *O. barrinensis* and *O. athertonensis*, by t-test.

Character	t	d.f.	P and significance
AW	2.197	24	$0.05>P>0.02$*
PW	4.536	24	<0.001***
SB	3.637	24	$0.01>P>0.001$**
PL/AL	1.856	22	$0.1>P>0.05$, n.s.
PW/LB	2.281	24	$0.05>P>0.02$*
AW/AP	0.1633	24	$0.9>P>0.8$, n.s.
AW/TiIII	0.9471	24	$0.4>P>0.3$, n.s.
PW/TiIII	1.495	24	$0.2>P>0.1$, n.s.
PSB/SB	3.205	24	$0.01>P>0.001$**
PW/AP	0.288	24	$0.8>P>0.7$, n.s.

*Significant at the 0.05 level of probability
**Significant at the 0.01 level of probability
***Significant at the 0.001 level of probability
n.s. not significant.

Acknowledgments

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A NEW MIDDLE TERTIARY CROCODILE FROM LAKE PALANKARINNA, SOUTH AUSTRALIA

P. M. A. WILLIS & R. E. MOLNAR

WILLIS, P. M. A. & MOLNAR, R. E. 1991. A new middle Tertiary crocodile from Lake Palankarinna, South Australia. *Rec. S. Aust. Mus.* 25(1): 39–55.

Australosuchus clarkae is a new generalised Oligo-Miocene crocodilian from Lake Palankarinna, South Australia. It appears to be part of a recently recognised endemic Tertiary radiation of crocodiles in Australia.

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In another paper (Willis, Murray & Megirian 1990), the existence of an endemic Tertiary radiation of Gondwanan freshwater crocodilians in Australia was discussed. This speculation was based on zoogeographic considerations and apparently synapomorphic features possessed by *Pallimnarchus pollens, Quinkana fortirostrum* and *Baru darrowi.*

A new genus and species of crocodile from Oligo-Miocene sediments of South Australia appears to support this hypothesis. It is both the oldest described member of the group and, apparently, the most plesiomorphic. This species was noted by Molnar (1982) and probably by Stirton *et al.* (1968) and Estes (1984).

The following abbreviations for collections are used in this paper: AMNH, American Museum of Natural History, New York; NHMV P, Museum of Victoria, Melbourne; QM F, Queensland Museum, Brisbane; UCMP, University of California, Museum of Paleontology, Berkeley; SAM P, South Australian Museum, Adelaide.

SYSTEMATICS

Order: Crocodilia
Suborder: Eusuchia
Family: Crocodylidae
Australosuchus Willis & Molnar, gen. nov.

Type species

Australosuchus clarkae Willis & Molnar, sp. nov. (Figs 1a, b)

Generic diagnosis

Crocodiles of this genus differ from all other crocodylids in the following combination of features (apomorphies designated 'a'): moderately broad snouted; pseudoheterodont dentition; alveolar process present on premaxilla, maxilla and dentary; external nares raised, circular or ovate, with sharply defined margins; postorbital-squamosal contact on skull roof V-shaped, apex directed posteriorly (a); five alveoli occur in premaxilla; fourteen alveoli occur in maxilla; sixteen to seventeen alveoli occur in dentary; dentary tooth reception pits are excluded from margins of premaxilla and maxilla; fourth dentary tooth reception pit is semi-enclosed (a); symphysis extends posteriorly to level of fourth or fifth dentary alveolus.

Differential diagnosis and discussion

Australosuchus clarkae differs from other Australian crocodiles in the following features: *A. clarkae* lacks interlocking dentition, an anterior process of the palatines and has the fourth dentary tooth accommodated in a pit rather than a notch as in species of *Crocodylus.* The first of these features is apparently plesiomorphic for crocodiles, the second is probably apomorphic for certain Australian crocodiles (Willis *et al.* 1990), and the third is also found in alligatorines. As discussed below, *Australosuchus* seems to have no other alligatorine affinities, and so this feature is probably convergent and an apomorphy for *Australosuchus. Australosuchus* does not have ziphodont features as seen in *Quinkana fortirostrum* and it is smaller than both *Baru darrowi* and *Pallimnarchus pollens. Australosuchus clarkae* is also distinguished from these three fossil crocodilians by the fourth dentary tooth reception pit, the extent of the dentary symphysis and the more posterior position of the palatal fenestrae (a plesiomorphic feature). In these features, *A. clarkae* is sufficiently different to justify the erection of a new genus.

Etymology

The generic name is derived from the Latin *australis* meaning southern and *suchus* meaning crocodile. The gender is masculine.

Australosuchus clarkae Willis & Molnar, sp. nov.

Holotype

QM F16788 (Fig. 1a, b), an almost complete skull and mandible, incomplete cervical and dorsal vertebrae, scapula, humerus and dermal armour, collected by Michael Archer in 1975.

Type locality

An unnamed site from the base of the eastern end of the bluff that yielded the Tedford Local Fauna and Tedford East Local Fauna, Lake Palankarinna, South Australia.

Paratypes

NHMV P188441, right premaxilla and maxilla; SAM P27932, premaxillary fragment; SAM P27847, maxillary fragment; SAM P27933, maxillary fragment; NHMV P188437, right maxillary fragments; QM F18102, jugal; SAM P29580, jugal; NHMV P188439, right jugal; NHMV P188440, right jugal fragment; SAM P27841, frontals; SAM P10892, frontals; AMNH 23047, left postorbital and half of frontal; QM F17985, frontal, parietal and postorbital; AMNH 23048, right postorbital; AMNH 23049, parietal; AMNH 23052, right quadrate; AMNH 23051, left quadrate and squamosal fragment; QM F17433, right quadrate; QM F17986, squamosal (possibly from the same individual as QM F17985); QM F17984, squamosal; AMNH 23050, basioccipital; NHMV P166441, right exoccipital; QM F17983, exoccipital with quadrate fragment; SAM P27934, dentary, angular and squamosal; SAM P27827, dentary; SAM P29083, dentary; SAM P23985, dentary; NHMV P166439, right dentary; NHMV P160360 and NHMV P160357, right dentary fragment (two fragments of the same specimen that have been catalogued separately); NHMV P166442, left dentary; SAM P30162, right dentary; UCMP 57071, right dentary; UCMP 70941, left dentary; QM F18152, right dentary; QM F18151, left dentary; UCMP 100028, surangular; SAM P23985, surangular; NHMV P188436a, right surangular; NHMV P188438, right surangular; QM F17988, incomplete angular; SAM P23985, angular; SAM P29578, angular; SAM P29579, angular; NHMV P188436b, left angular fragment; AMNH 23055, cervical vertebral

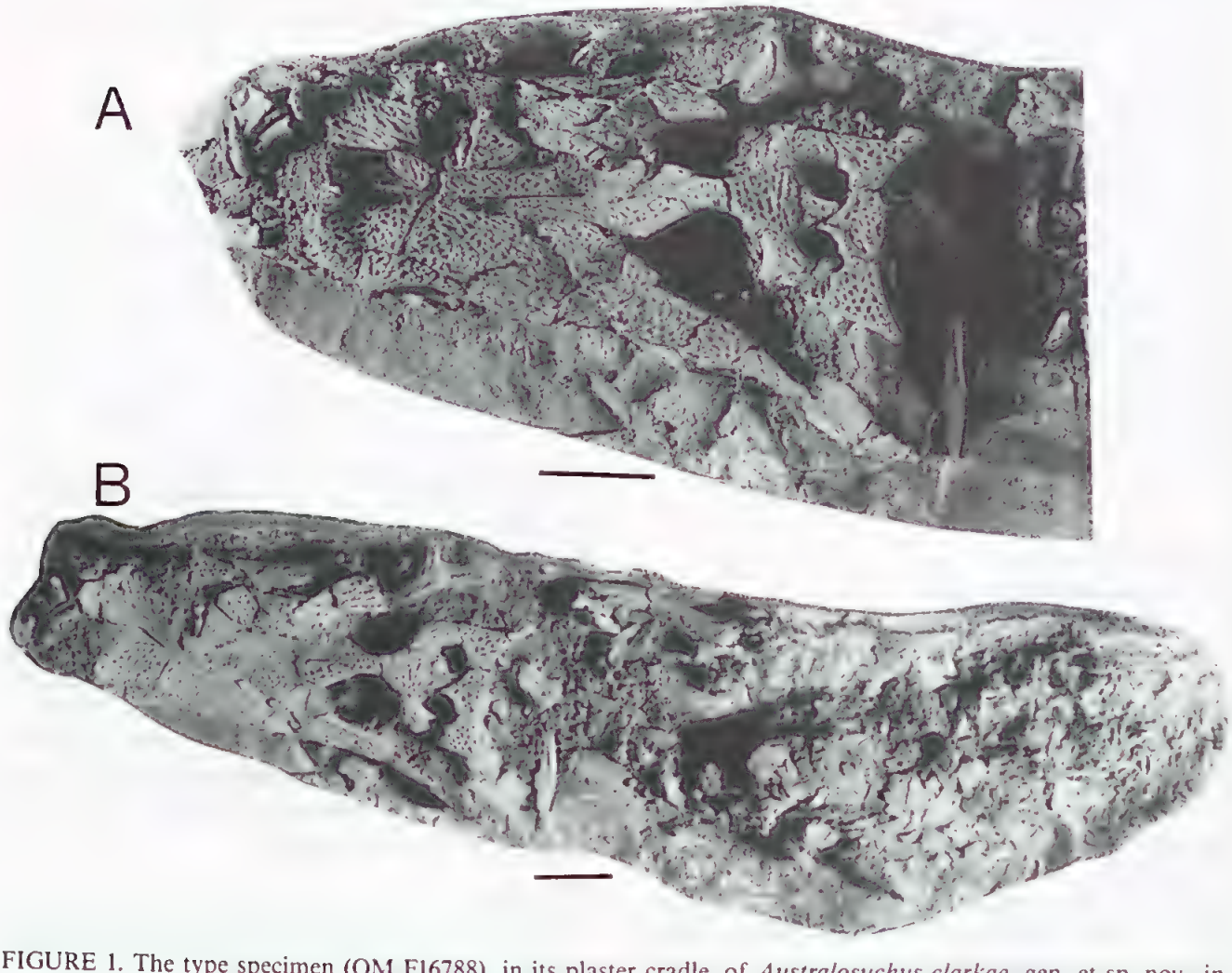


FIGURE 1. The type specimen (QM F16788), in its plaster cradle, of *Australosuchus clarkae*, gen. et sp. nov., in dorsal view. A, Skull. B, Entire specimen. Scale bars 5 cm.

centrum; SAM P27829, cervical vertebral centrum; AMNH 23056, neural arch; AMNH 23057, caudal vertebral centrum and neural arch; QM F17987, dorsal vertebra; AMNH 23054, cervical rib; SAM P24656, a right hind limb consisting of femur, tibia, fibula, a partial third tarsal, all metatarsals, one phalange and claw from the first digit, three phalanges and claw from the third digit and two phalanges from the fourth digit; SAM P30161, right femur; SAM P27830, right coracoid; SAM P27828, right third metatarsal; SAM P30160, right humerus; all from the Etadunna Formation, Lake Palankarinna, South Australia.

Paratype material from other localities includes: AMNH 12177, premaxilla and two teeth and AMNH 12200, a skull, both from the Namba formation, Lake Pinpa; NHMV P188442, right angular fragment from the Namba formation, Lake Tarkarooloo; UCMP 88192, jugal and quadratojugal and UCMP 71396, left premaxilla and maxilla both from the Wipijiri formation, Lake Ngapakaldi; UCMP 100027, frontals, UCMP 57069, dentary and UCMP 57071, dentary all from the Mampuwordu Sands, Lake Palankarinna.

AMNH 12200 is a large skull that is badly shattered (Fig 2). It can be referred to this species but is too poorly preserved to be of much descriptive value.

There are numerous other crocodilian fragments from Lake Palankarinna in the collections of the South Australian Museum and the Queensland Museum. These specimens are too small or broken to be of use. However, a search through these fragments revealed no specimens that clearly differed from those described here.

Various unnumbered specimens from the collections of the Queensland Museum and the South Australian Museum are also of use and are included here as paratypes.

Stratigraphy, fauna and age

The holotype derives from the Etadunna Formation. It belongs to an undetermined local fauna that is some two metres below the Tedford East Local Fauna and at a level that is stratigraphically comparable to the occurrence of *Muramura williamsi* (Pledge 1987; Archer, pers. comm.). This local fauna is most likely to be late Oligocene to early Miocene in age (Callen *et al.* 1987; Archer *et al.* 1990).

Paratype specimens from the Etadunna Formation belong to the Ditjimanka Fauna. AMNH 12200 and AMNH 12177 pertain to the Pinpa Local Fauna. NHMV P188442 belongs within the Lake Tarkarooloo Local Fauna. UCMP 88192 and UCMP 71396 belong to the the Kutjamarpu Fauna. Current understanding of the biostratigraphy places these faunas within the late Oligocene or early Miocene (Callen *et al.* 1987, Woodburne *et al.* 1985).

UCMP 100027, UCMP 57069 and UCMP 57071 are from the Mampuwordu Sands, Lake Palankarinna. The Mampuwordu Sands are thought to be late Pliocene or possibly early Pleistocene in age (Callen *et al.* 1987, Woodburne *et al.* 1985). Either this species of crocodile was conservative in its morphology over this period of time or the site information for these three specimens is incorrect. Considering that the Mampuwordu Sands are a channel cut into the Etadunna Formation, it is possible that these Mampuwordu crocodile specimens were reworked from the older Etadunna Formation or that their stratigraphic province was incorrectly interpreted at the time of collection. At present, we assume the site information for the supposed Mampuwordu Sands specimens is incorrect. Thus we suggest this species is most likely restricted to the late Oligocene or early Miocene.

Etymology

The specific name is in honor of Mrs Elaine Clark in recognition of her continuing support for the Riversleigh Research Project.

Specific diagnosis

As for the genus until new species are recognised.

Descriptions

The following descriptions are primarily based on the holotype, the most complete specimen. The paratypes were used to supplement this information because many elements on QM F16788 are incomplete, badly fractured or covered by matrix. Paratypes are noted where used. Fig 3 shows reconstructions of the skull, based on specimens shown in Fig. 4.

QM F16788 was chosen as the holotype for two reasons: it retains most of the skull elements and, although crushed and fractured, its skull could be reasonably well reconstructed; second, it is the only specimen that unambiguously associates cranial and postcranial elements.

Premaxillae: The premaxillae on QM F16788 are broken and incomplete so this description is based mainly on SAM P27932, AMNH 12177, NHMV P188441 and UCMP 71396 (Fig 5).

The external nares are raised. They are circular and slightly flared on SAM P27932, but on UCMP 71396 the nares are ovate, being wider than long. On both specimens the nares have sharply defined margins.

AMNH 12177 has two unattached teeth associated with it. They are ovate in cross section, with non-serrate anterior and posterior carinae. The larger has vertical ribs on the lingual surface. These

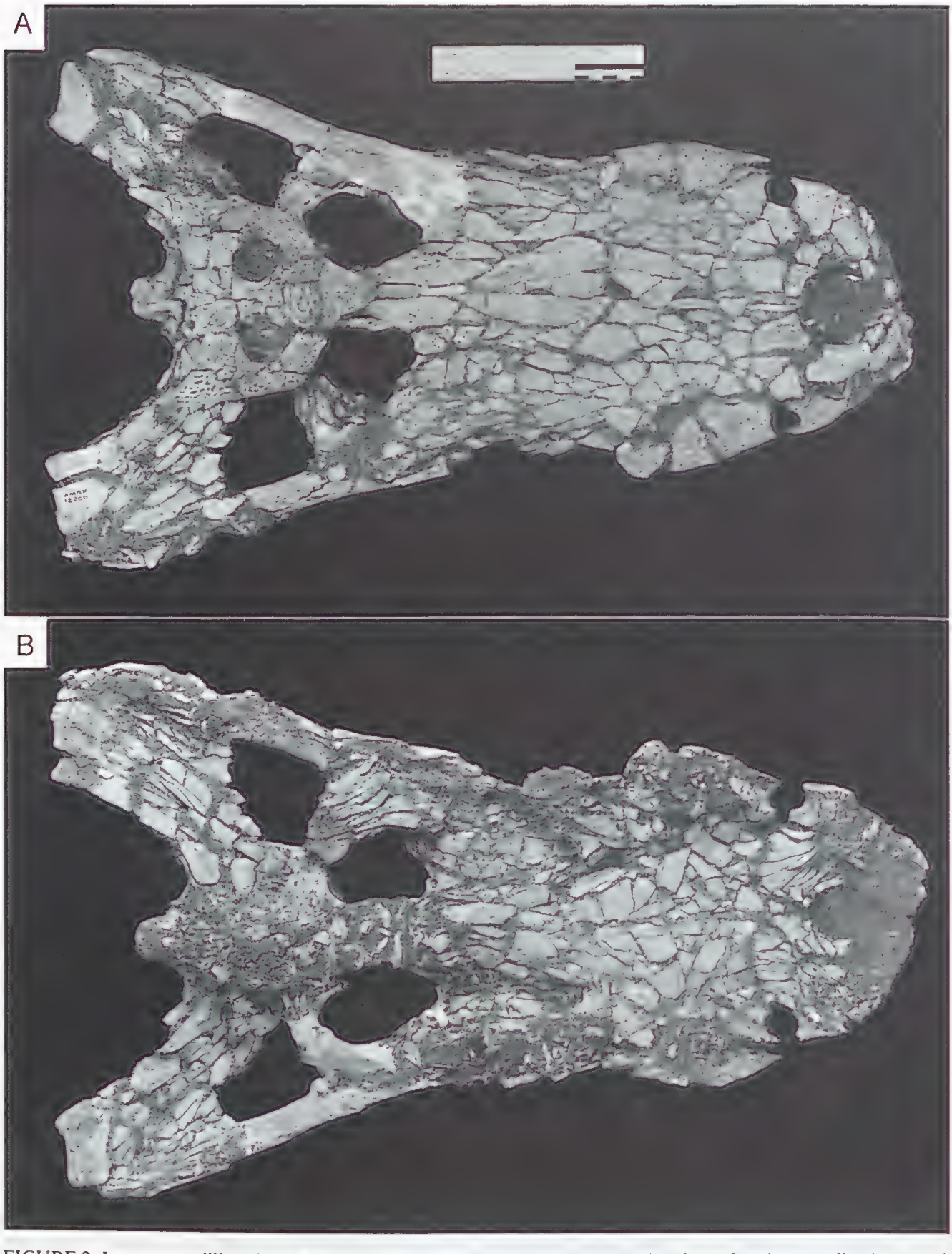


FIGURE 2. Large crocodilian skull (AMNH 12200) from the Namba Fm. of Lake Pinpa, South Australia. A, Dorsal view. B, Ventral view. This somewhat crushed specimen is probably referable to *A. clarkae*. Scale in inches and cm.

are the only teeth associated with any of the premaxillae.

There are five alveoli. The first and second are subequal in size, the third is larger and the fourth is very large. The fifth is intermediate in size between the second and third.

Dentary tooth reception niches occur between, and lingual to, the upper series and are excluded from the margins. The first niche is very deep and separates the first and second premaxillary alveoli. It does not erupt through the dorsal surface on SAM P27932 but does on UCMP 71396. The other niches are more shallow. The fourth dentary tooth reception pit is semi-enclosed, mostly hiding the fourth dentary tooth when the mouth is closed and thus resembling the alligatorine, rather than the crocodyline, condition. This is an unusual and distinctive feature. The premaxilla is built up around the tooth bases to form a distinct alveolar process. The sculpture consists of distinct oval pits around the margins and indistinct pits on the dorsal surface. The foramen incisivum is relatively large and ovate.

AMNH 12200 shows that the premaxillae are separated by the nasals on the dorsal surface, posterior to the nares, a feature not clear in any other specimen.

Maxillae: The maxillae of QM F16788 are almost complete but crushed and broken. The ventral surfaces are obscured by matrix and mandibular elements. The maxilla of UCMP 71396 is complete and uncrushed. NHMV P18841, NHMV P188437, SAM P27933 and SAM P27847 are less complete maxillary fragments. This description is based on these specimens.

The shape of the maxilla indicates a moderately broad and flat snout with fourteen alveoli. A moderately developed alveolar process is present, accommodating the anterior six alveoli.

No crowns are associated with any maxilla, except that of the type, where the left fourth and fifth are present. These are oval in section with marked anterior and posterior carinae. The alveoli are round, becoming ovate posteriorly. The sequence of tooth size is typically crocodyline (as judged by the size of the alveoli) with the fifth tooth being the largest. The alveoli increase in size from the first to the fifth then decrease in size to the seventh. They then increase in size again until the tenth and then decrease in size posteriorly. The third and tenth alveoli are about the same size but larger than the second, sixth, eighth and fourteenth alveoli which are also about the same size. The alveolar spacing is interrupted by dentary tooth reception pits between and lingual to the sixth and seventh alveoli, and between and lingual to the seventh and eighth alveoli.

Tooth reception pits are excluded from the margins and indicate that the teeth did not fully interlock. Well defined tooth reception pits are located between and lingual to the sixth and seventh alveoli, the seventh and eighth alveoli, the eighth and ninth alveoli and between the ninth and tenth alveoli. Less well defined pits occur between the first and second alveoli and posterior to the tenth.

The palatal suture with the premaxilla is a shallow W-shape and there is no clear sign of a contact with the palatine. However, the mid-line maxillary suture can be seen to extend posteriorly to the level of the anterior margins on the palatal fenestrae. This indicates that this species lacked an anterior palatal process. The ectopterygoid suture reaches anteriorly to the posterior edge of the twelfth alveolus. The palatal fenestrae reach anteriorly to the level of the ninth alveolus. The dorsal sutural contact with the nasal is nearly straight and almost parallel to the midline, but slightly constricted anteriorly.

Sculpture is shallow on the maxilla, consisting of low surface markings, pits anteriorly and grooves posteriorly.

Nasals: Both nasals on QM F16788 are crushed and broken. While no other specimens preserve the nasals, some inferences about these bones can be drawn from UCMP 71296 (premaxilla and maxilla), AMNH 12200 (a skull) and from UCMP 100027, (frontals and prefrontals).

The nasals entered the external nares, flared slightly toward the posterior until their contact with the lacrymals, then tapered posterior from that point. An anterior process of the frontals separated the posterior extremities of the nasals.

Jugals: The jugals of the type specimen are crushed and broken and the right has fallen away from the remainder of the skull so that the medial face is exposed. This description is also based on UCMP 88192, NHMV P188440, NHMV P188439 and SAM P29580 (Fig. 6a–d).

The jugals are slender and gracile. The postorbital bar is inset but there is no trough between it and the lateral face of the jugal. The postorbital bar has a weakly developed buttress on the medial surface that ventrally is deflected sharply forward. A very large nutrient foramen lies on the medial surface, anterior to the base of the postorbital bar. On UCMP 88192 and the type, there are two foramina here. The sculptured surface of the jugal extends ventrally under the region of the postorbital bar.

Quadratojugals: The quadratojugals on QM F16788 are broken and partially displaced. An almost complete quadratojugal is present in UCMP 88192. It is broad and ventrally thickened. The presence or absence of an anterior spike cannot be determined. Only subdued sculpture is present, and the ventral portion of the lateral face, behind the jugal contact, is flexed to be directed ventrolaterally.

Quadrates: The right quadrate of QM F16788 is

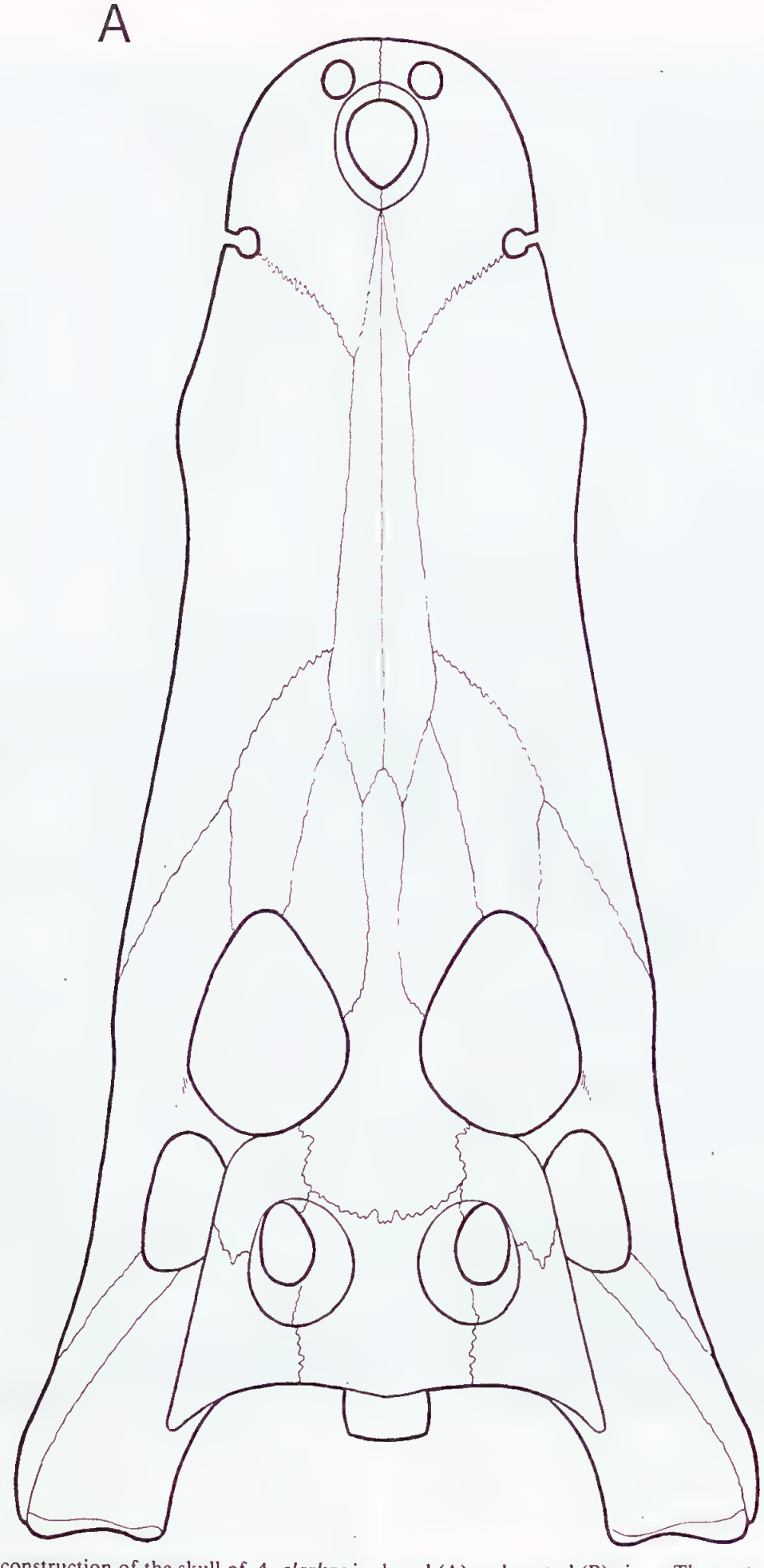
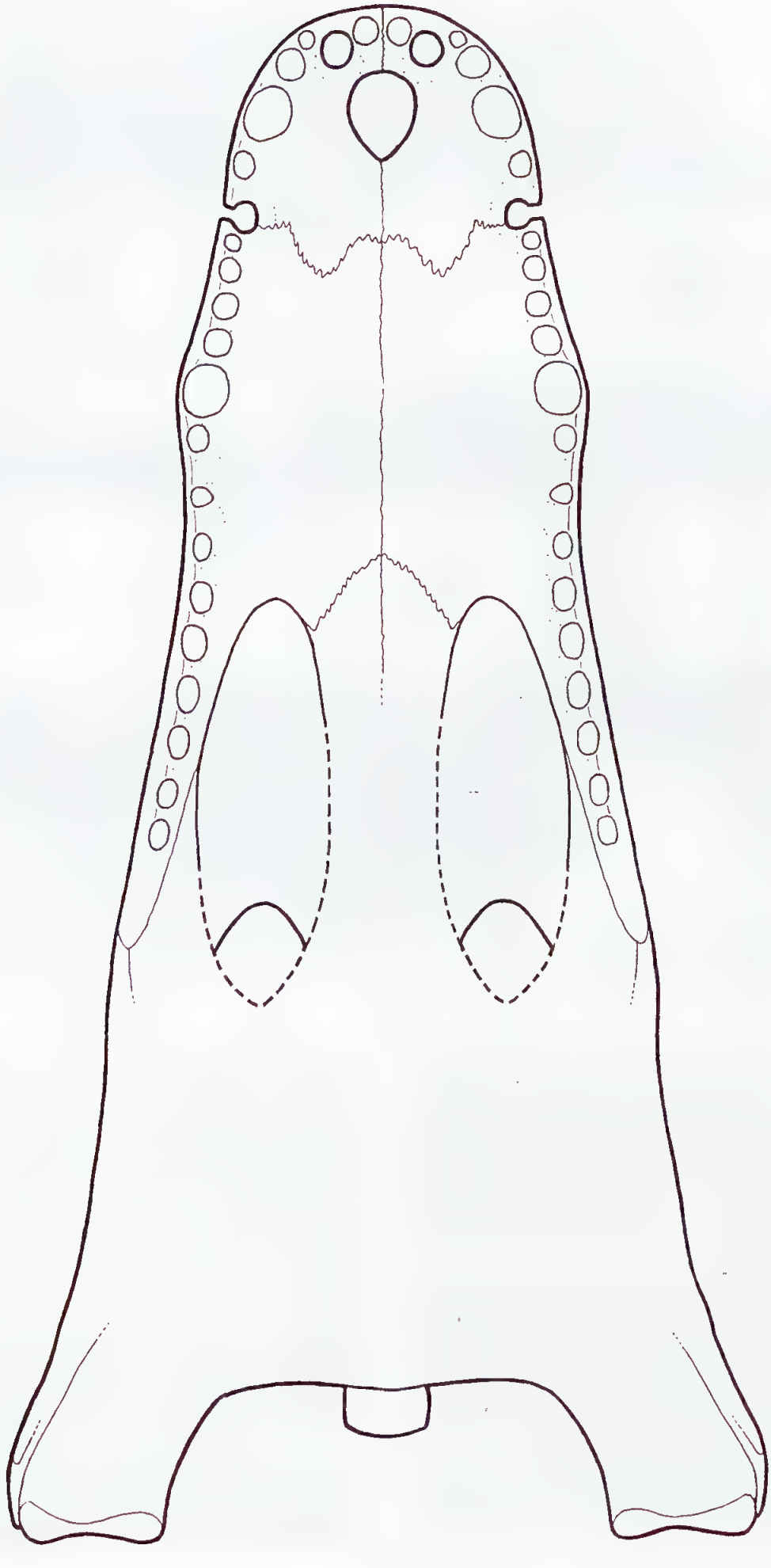


FIGURE 3. Reconstruction of the skull of *A. clarkae* in dorsal (A) and ventral (B) views. The posterior part of the palatal surface is unknown.

B



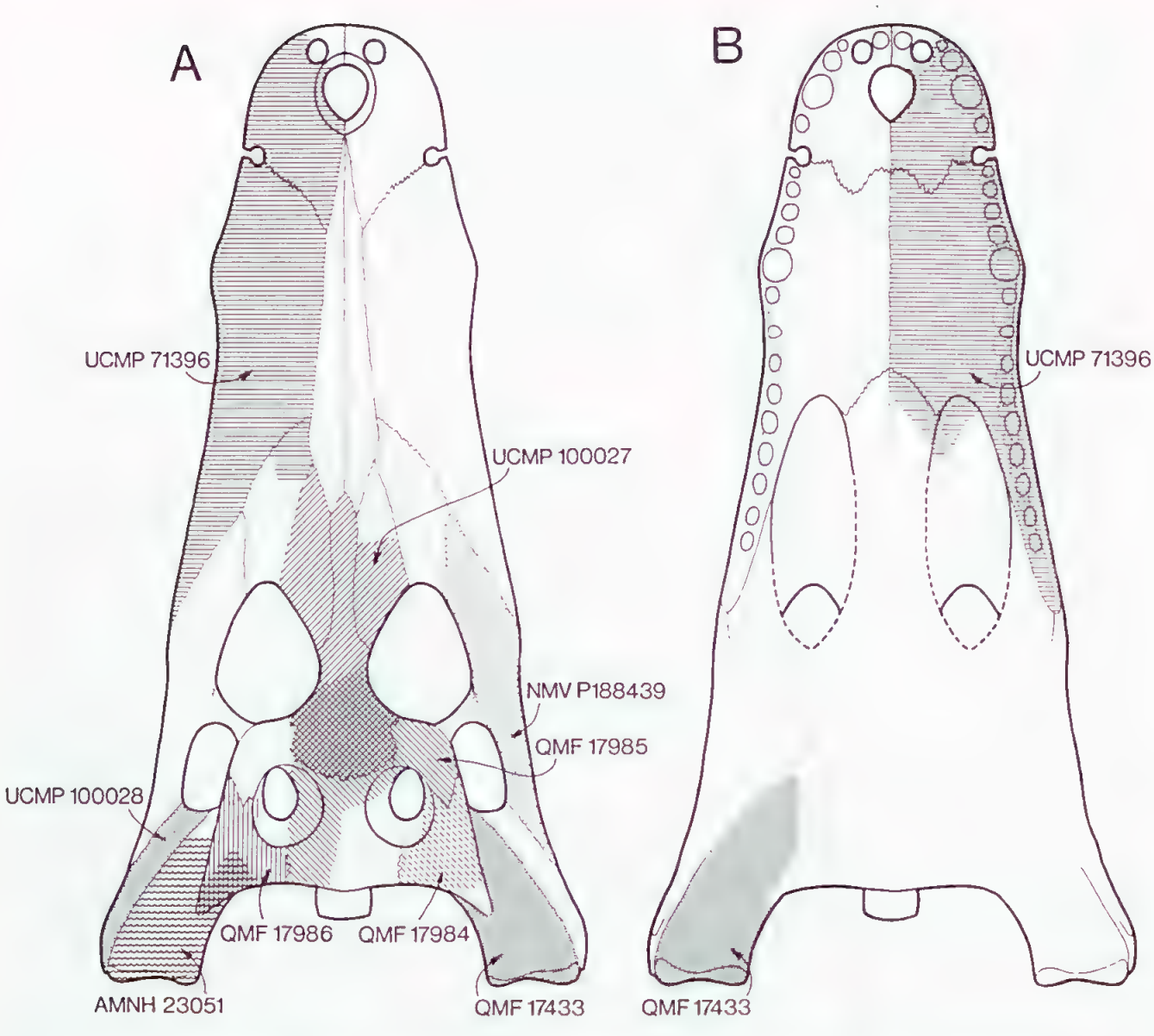


FIGURE 4. Specimens upon which the cranial reconstruction is based. A, Dorsal view. B, Ventral view.

missing and the left quadrate is broken and somewhat obscured by other elements. AMNH 23052 a right quadrate, AMNH 23051 a left quadrate and squamosal, and three unnumbered specimens (two right, one left, all missing the anterior portions) in the collections of the Queensland Museum form the basis of the description (Fig. 7)

The dorsal contact with the squamosal has a prominent plinth. A well developed crest on the ventral surface (equivalent to the B crest of Iordansky (1973)) is orientated parallel to the quadratojugal suture. Posteriorly this crest curves laterally, toward the quadratojugal suture which it meets just anterior to the condyle (Iordansky's B' crest). The sutured margin with the quadratojugal is quite deep posterior to the level of the paroccipital process, becoming more shallow anteriorly. The dorsal platform between the condyle and the paroccipital process is quite wide. A distinct, almost pit-like, excavation on the ventral face lies just anterolateral to the medial condyle.

Lacrymals: Both lacrymals on QM F16788 are crushed and broken but complete. The only lacrymal material known from the paratype collection is a small fragment attached to UCMP 71396.

The lacrymals are relatively long and narrow. They form the antero-lateral margin of the orbits which are large and constricted anteriorly. They have an extensive medial contact with the nasals. The lacrymal duct and ventral surfaces cannot be traced in these specimens.

Prefrontals: The right prefrontal of QM F16788 is severely broken, but the left has suffered only one break near its centre and is apparently complete.

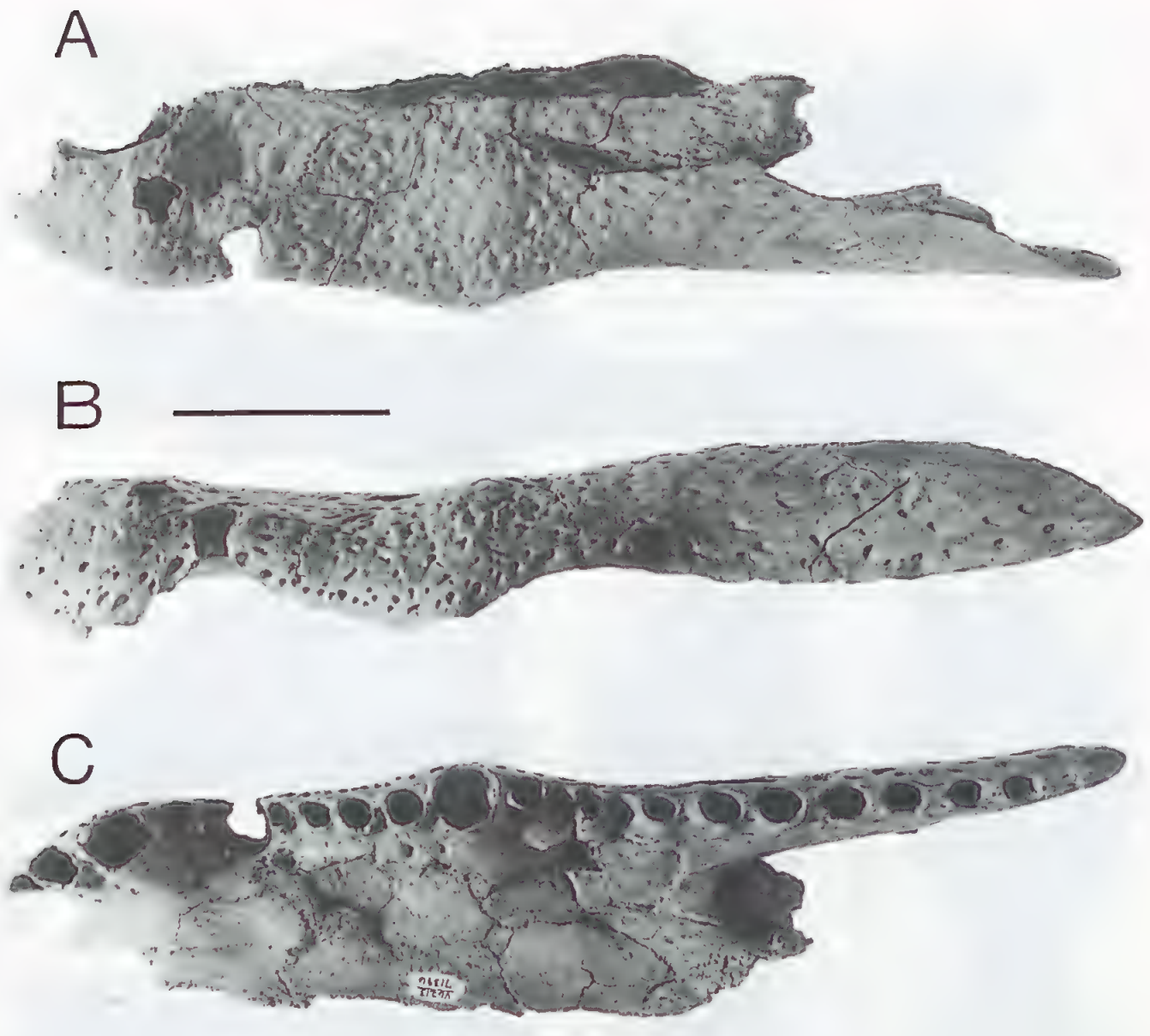


FIGURE 5. The left premaxilla and attached maxilla of *A. clarkae* (UCMP 71396) in dorsal (A), lateral (B) and ventral (C) views. Scale bar 5 cm.

UCMP 100027 preserves both left and right prefrontals; the right is incomplete anteriorly and both lack the delicate descending process.

The prefrontals are basically isosceles triangles with the apex directed laterally. The anterior process is relatively long and the posterior extremity of the nasals separates the anterior tip of the frontals from the prefrontals. Although the orbit margins are not raised, they are sharply defined and steeply angled to the external surfaces. There is a slight continuation of the *cristae cranii frontales* onto the posterior part of the ventral surface of the prefrontals. Sculpture consists of deep elongate pits.

Frontals: The frontals of QM F16788 are broken in one place. SAM P27841 and SAM P10892 are complete frontals, UCMP 100027 are complete frontals with prefrontals and part of the nasals (Fig. 6e, f) and AMNH 23047 is half a left frontal and a postorbital. All are similar but AMNH 23047 is smaller than the others.

The frontals of this species are slightly concave posteriorly due to raised orbital rims. They are heavily built (particularly posteriorly), narrow between orbits and lightly sculptured with pits. The anterior process is relatively long and anteriorly separates the posterior extremities of the nasals. Ventral ridges around orbits (*crista cranii frontales*) are not as well developed as in *C. porosus* of similar size, but in AMNH 23047 they are more pronounced than in the other specimens. The frontals do not participate in the margins of the supratemporal fenestrae. The dorsal suture with the

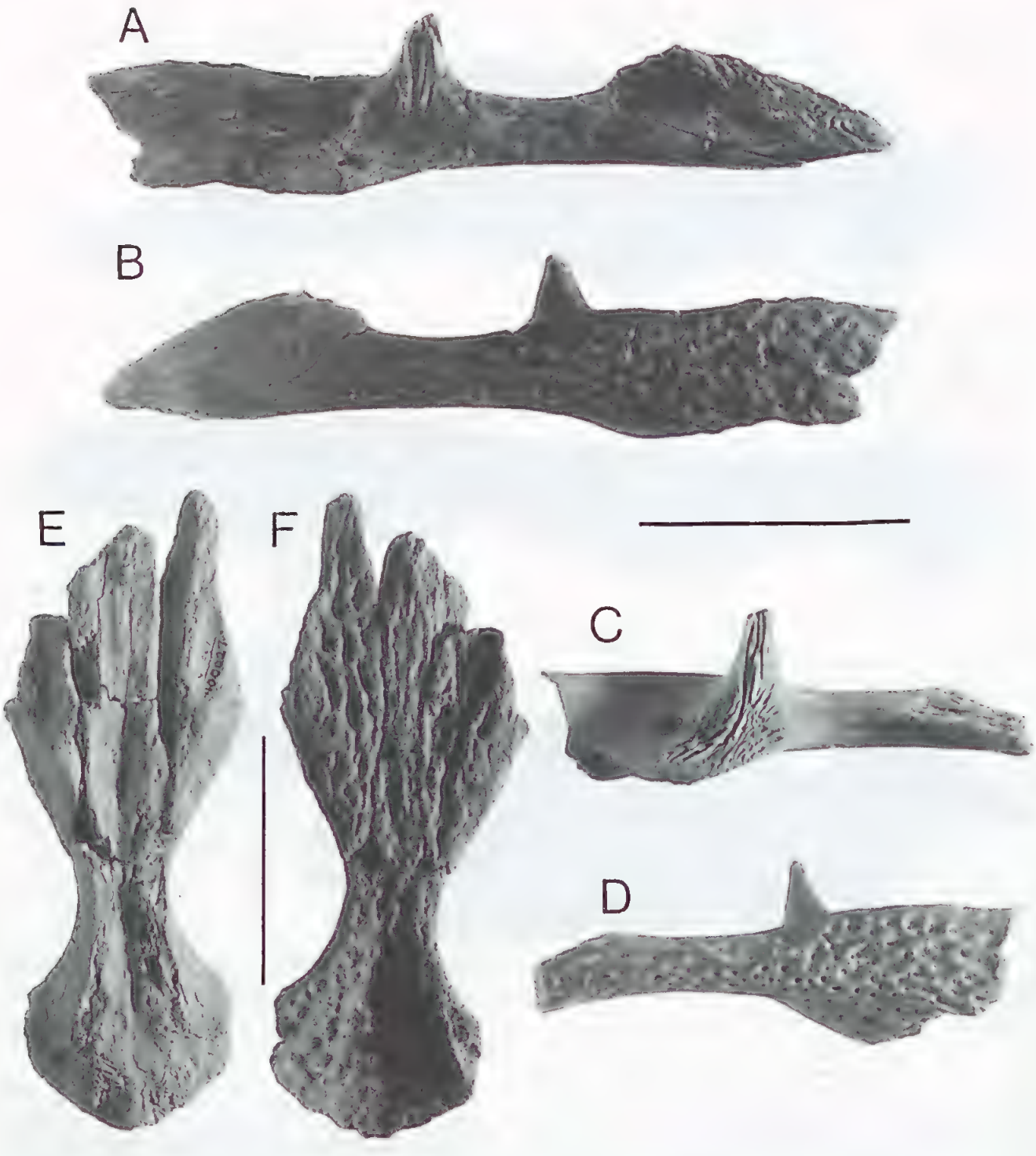


FIGURE 6. The right jugal with attached quadratojugal of *A. clarkae* (UCMP 88192) in medial (A) and lateral (B) views. The right jugal (QM F18102) in medial (C) and lateral (D) views. The frontals (UCMP 100027) in ventral (E) and dorsal (F) views. Scale bars 5 cm.

FIGURE 7. The right quadrate of *A. clarkae* (QM F17433) in ventral (A), medial (B) and dorsal (C) views. Scale bar 5 cm.

postorbital is directed medially then posteriorly in some specimens (UCMP 100027 and some unnumbered specimens in the Queensland Museum) but not in others (*e.g.* QM F16788).

Parietals: The parietals are preserved on QM F16788 but are broken between the supratemporal fenestrae. AMNH 23049 is a complete parietal, QM F17985 is a frontal, parietal and postorbital, and there are unnumbered parietals in the collection of the South Australian Museum.

The dorsal surface of this element is shallowly concave, posteriorly rising to the dorsal margins of the supratemporal fenestrae. The supratemporal fenestrae are large and round and the parietals are constricted between them. Anteriorly, the parietals send a thin lateral process to the postorbital, separating the frontals from the supratemporal fenestrae. There is a well-developed transverse bar on the ventral surface in the region of the diencephalon.

Postorbitals: QM F16788 has both postorbitals preserved, but both have the postorbital bar broken and the left is posteriorly incomplete. AMNH 23047 is a left postorbital and half frontal, QM F17985 is a frontal, parietal and postorbital, and AMNH 23048 is a right postorbital.

The postorbital is flat on the dorsal surface and relatively thick. There is a deep nutrient foramen on the anterolateral edge, at the top of the postorbital bar. QM F17985 shows a posterior process on the dorsal surface that overlaps the squamosal, separating the lateral and medial sides of its anterior extremity.

Squamosals: Both squamosals are preserved in QM F16788. AMNH 23051 is a left squamosal fragment attached to a quadrate. QM F17986 is a squamosal (possibly from the same individual as QM F17985) and QM F17984 is also a squamosal.

This relatively thick element is flat on the dorsal surface, forms the posterolateral margins of the supratemporal fenestrae and has a well-defined lateral edge forming the dorsal margin of the temporal arcade. This edge has a ventral lip. The anterior process extends under the postorbital. The squamosal extends further ventrally on the posterior wall of the skull than in *C. porosus* and the posterolateral crest of the squamosal is better developed than on *C. porosus* and continuous. The posterior face of the squamosal is concave.

Basioccipital: On QM F16788 the basioccipital is obscured. AMNH 23050 is a basioccipital. There is one unnumbered basioccipital in the UCMP collection, assumed to represent this species because of its locality and similarity to QM F16788 and AMNH 23050.

This element is narrower and extends further ventrally than in *C. porosus.* There is a deep eustachian foramen ventrally and a well-developed medial ridge on the ventral part of the posterior wall. Unlike *C. porosus,* the eustachian foramen is not enclosed by the basioccipital; the posterior half of the eustachian foramen is bounded by the basioccipital. The occipital condyle is set on a prominent neck, that projects further than in *C. porosus.*

Exoccipitals: Only the posterior wall of the exoccipitals of QM F16788 are visible. These are broken and partially obscured. NHMV P166441 is a right exoccipital. The ventral portion of QM F17983 is an exoccipital including the base of the paraoccipital process to the foramen magnum.

The positions of the foramina for cranial nerves X, XI and XII are as in *C. porosus.* The broken ventral face reveals the passage for the posterior carotid, and the broken dorsal surface exposes the internal chambers of the exoccipital that occupy the bulk of this element. The posterior face is more strongly convex than in *C. porosus* and the posterior opening of the cranio-quadrate passage is very close to the ventral margin.

Other skull elements: Palatines, vomers, basisphenoids, laterosphenoids, pterygoids and ectopterygoids have not been identified. They are all presumably present on QM F16788 but may be obscured by matrix and other bones.

Dentaries: The anterodorsal portion of the left dentary is present in QM F16788 but it is badly broken. The right dentary is possibly present but covered by matrix. Paratypes SAM P27934, SAM P27827, SAM P29083, SAM P23985, SAM P30162, NHMV P166439, NHMV P160360 (and NHMV P160357), NHMV P16644, UCMP 57071, UCMP 70941, QM F18151, QM F18152 and unnumbered specimens in the collection of the Queensland Museum are all dentaries (Figs 8 and 9).

The dentary is moderately broad and pseudoheterodont with an alveolar process that varies in development according to tooth size and extends back to at least the fourteenth alveolus. Pseudoheterodonty and the development of the alveolar process may be related to ontogeny because these features are not as strongly developed in small (presumably younger) specimens. The dentary body deepens posteriorly from the level of the fifteenth alveolus.

SAM P29083 and SAM P23985 display sixteen alveoli but QM F18152 displays seventeen in the right dentary. The teeth are arranged in a typically crocodyline sequence of enlargement. The first and fourth alveoli are the largest. The second, third and

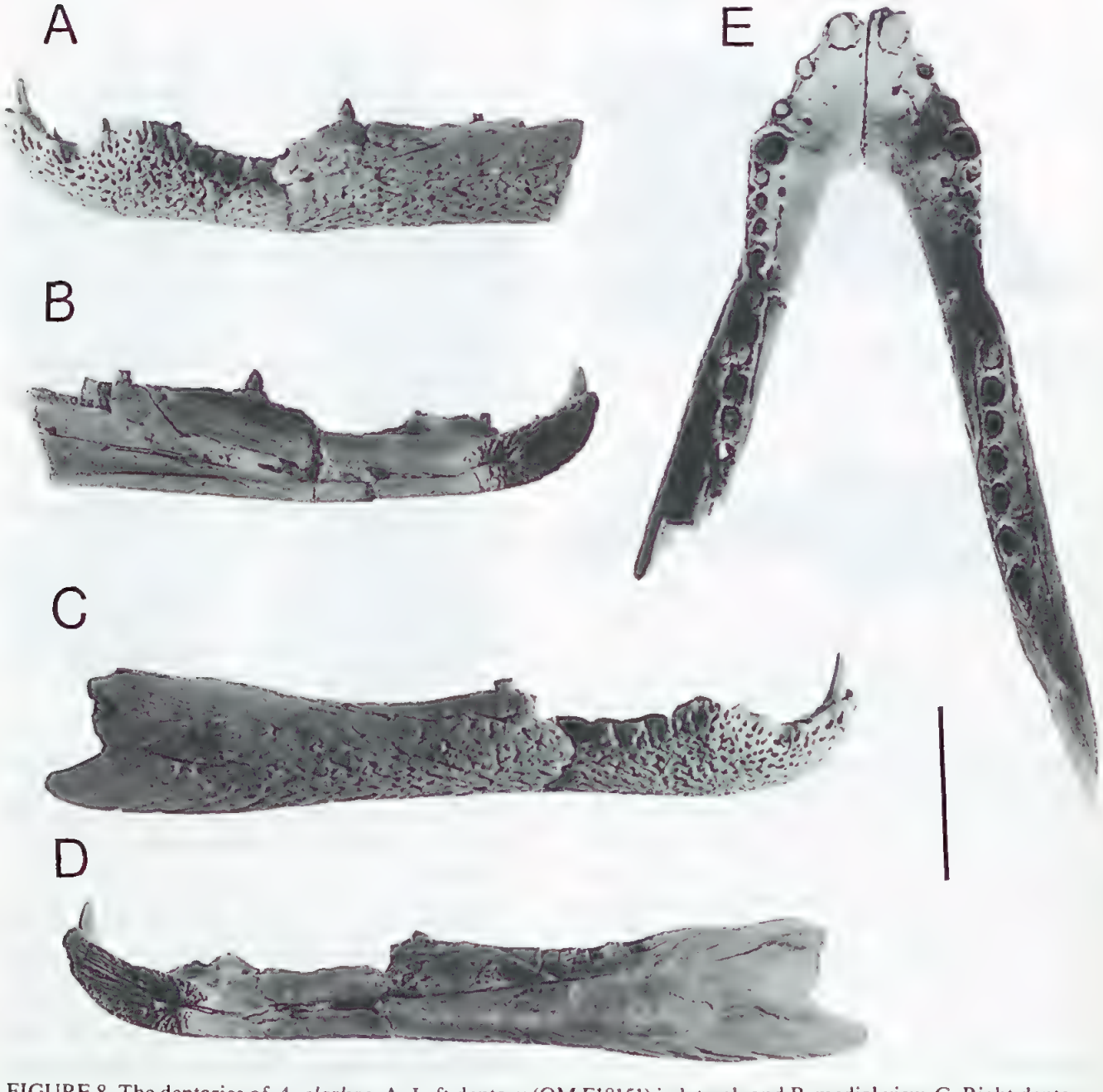


FIGURE 8. The dentaries of *A. clarkae*. A, Left dentary (QM F18151) in lateral, and B, medial view. C, Right dentary (QM F18152) in lateral, and D, medial view. E, Both dentaries articulated in dorsal view. Scale bar 5 cm.

FIGURE 9. Left dentary with articulated angular and surangular (SAM P23985) of *A. clarkae*. A, Lateral view. B, Dorsal view. C, Medial view. D, Ventral view. Scale bar 5 cm.

the fifth through to the tenth teeth are all similar and smaller in size. The teeth posterior to and including the eleventh are similar in size and intermediate between the size of the smaller and larger teeth in the anterior of the dentary. The anterior alveoli are round but posterior alveoli are ovate. SAM P30162 is a more robust dentary and the fourth dentary alveolus is greatly enlarged. This has forced the third and fifth alveoli more toward the medial than in the other dentaries.

There is a deep indentation between, and buccal to, the second and third alveoli to receive the fourth premaxillary tooth. Other such indentations are located between and buccal to the first and second, fifth and sixth, sixth and seventh, seventh and eighth, and eight and ninth alveoli.

The symphysis extends posteriorly to the fourth alveolus in some (UCMP) specimens and the fifth alveolus in others. The splenial extends to the level of the seventh alveolus in some specimens and the eighth alveolus in others but this feature cannot be seen in all specimens. The symphyseal region is broad and upswept anteriorly. It is markedly broader than in *C. porosus* of comparable size.

Sculpture is of small point-like pits anteriorly and posteriorly, with sulci extending posteriorly from

these pits. A distinct row of dorsally opening buccal foramina occurs parallel to the margin of the dentary from the medial side of the first alveolus to the seventh alveolus.

The first, second, third, fifth, eleventh and thirteenth crowns are present in QM F18151 and the fifteenth is present but broken. The first crown is slender, recurved and almost D-shaped in section, with mesial and distal carinae. The posterior face is longitudinally striate. In section the first crown is wider that it is long, being about two-thirds as long (anteroposteriorly) as broad (mesiodistally).

Of the second, third and fifth crowns, only the tips are visible but they appear to be laterally compressed with mesial and distal carinae.

The eleventh crown is blunt, but laterally compressed with mesial and distal carinae.

Surangulars: Neither of the surangulars of QM F16788 are clearly visible. Paratypes SAM P23985, NHMV P188438 and NHMV P188436a are surangulars. The surangular of this species does not appear to differ greatly from those of other crocodilians although it is slightly more gracile than normal.

Angulars: The angulars of QM F16788, if present, are obscured by matrix. Paratypes SAM P23985, SAM P29578, SAM P29579, NHMV P188442, QM F17988 and NHMV P188436b are all angulars.

The angulars, although basically similar to each other in general form, show a surprising amount of variation in detail. The longitudinal ridge on the floor of the internal, ventral canal may be well developed and prominent (as in SAM P23985 and SAM P23578) or low and poorly developed (as in SAM P29579). SAM P29578 has only one large foramen in the ventral canal whereas SAM P23985 and SAM P29579 have two small foramina. SAM P29578 has a flared rim extending from the posterior side of the internal ascending (coronoid) process flaring medially and extending posteriorly to the posterior ascending margin. This flared rim is not seen in the other specimens. However, these are minor differences and, considering the variation seen in comparing specimens of other crocodilians, there is no reason to suspect that these angulars do not represent the same species.

Other mandibular elements: The articulars, coronoids and splenials may be present on QM F16788 but if so are obscured by matrix. These elements were not identified among the paratypes.

Mandibular fenestrae: Both the external mandibular fenestrae and the inferior internal fenestrae are best preserved in SAM P23985.

The external mandibular fenestra is quite large for a crocodyline. It is subtriangular. The 'hypotenuse' forms the superior border, which is inclined to the ventral margin of the mandible.

The inferior internal foramen is only known from its ventral and posterior margins. These give the impression of a relatively large size for this foramen.

Postcranials: Although there are many postcranial elements associated with the holotype and paratypes, these are not described in detail here. Most are poorly preserved or do not differ significantly from comparative specimens of *C. porosus* and *C. johnstoni*. However, the following observations may be made with confidence: 1, all vertebrae apparently are procoelous; 2, cervical vertebrae (AMNH 23055) are strongly keeled; 3, dorsal arches (centra eroded prior to collection) are best preserved, lacking only the dorsal spine, and the prezygopophyseal facets are not laterally extended as in *C. porosus* (Fig. 10); 4, cervical arches are broken but resemble those of *C. porosus* (Fig. 11); 5, the humerus is broken and the articular ends are missing, but it agrees in proportions with that of *C. porosus*; 6, the coracoid and the preserved portion of the scapula visible are no different from those of *C. porosus*; 7, The numerous scutes have no keel and a sculpture of pits that are not as deep as those on the skull (Fig. 12); 8, long elements of the limbs (humerus, femur, tibia, fibula and metatarsals) are straighter than in either *C. porosus* or *C. johnstoni* but otherwise similar; 9, the vestigial fifth metatarsal is much more robust and thick than the corresponding element in other crocodilians.

Phylogenetic Affinities

At present, a phylogenetic systematic analysis of the affinities of *A. clarkae* is considered premature. Such an analysis will be more meaningfully conducted within the context of a broader examination of all Australian and non-Australian crocodilians, many of which are presently under study. Consequently the affinities of *A. clarkae* are here outlined in only a cursory manner.

The position of the choanae cannot be seen on any of the specimens. However, the basioccipital AMNH 23050 is notched on the ventral side of the anterior process to accommodate the narial passage. This indicates that the internal nares must have been situated posteriorly in the palate. This feature, together with the presence of procoelous vertebrae and the subdermal postorbital bar indicate that this is an advanced eusuchian crocodylid (Steel 1973). Although the semi-enclosed fourth mandibular tooth could suggest alligatorine affinities, the contact of the nasal and the lacrymal (seen in *Alligator* and some fossil alligatorines), the sequence of maxillary tooth enlargement (the fifth being the largest rather than the fourth, an alligatorine apomorphic character-state) and the general form of the skull indicate crocodyline

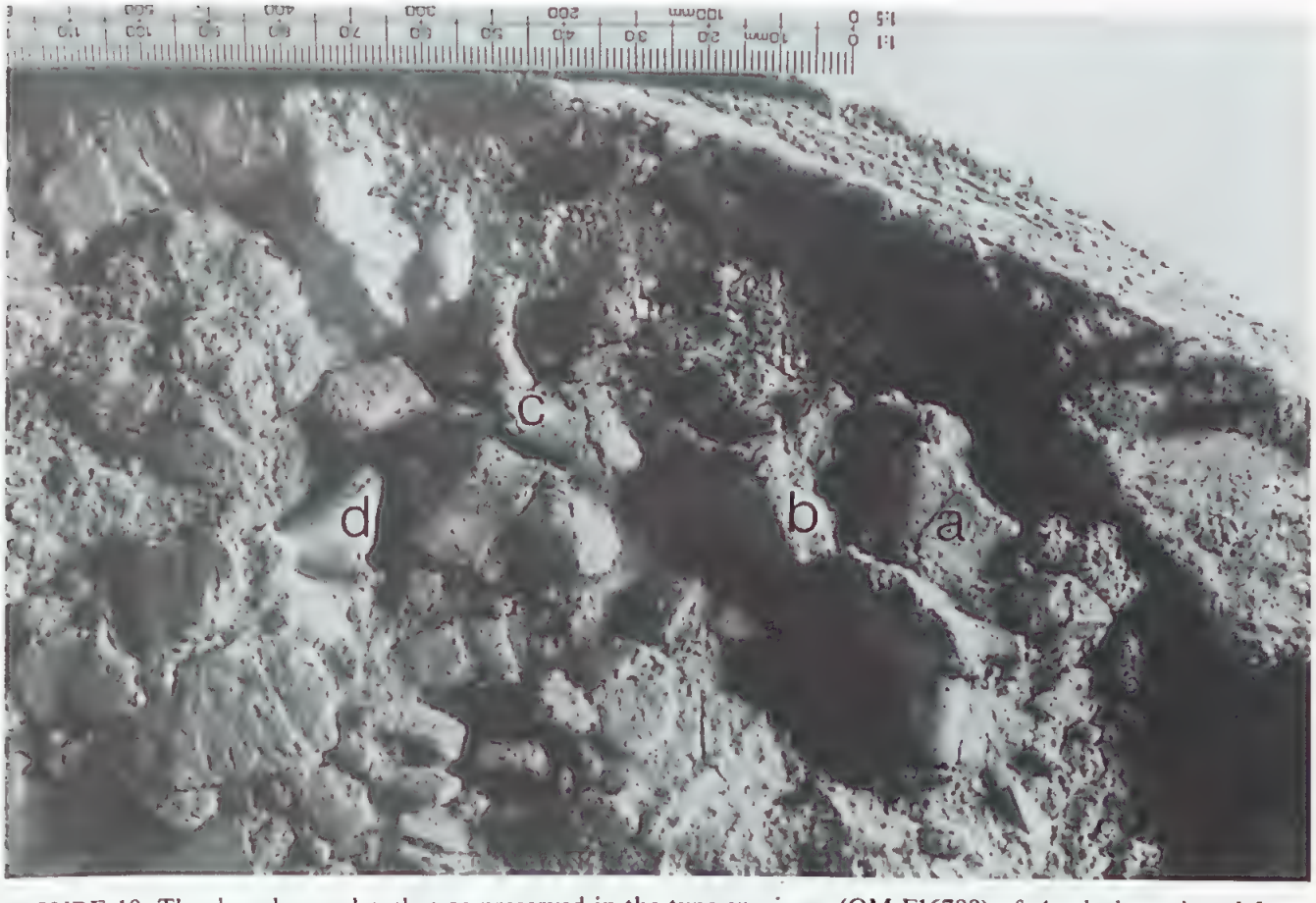


FIGURE 10. The dorsal neural arches as preserved in the type specimen (QM F16788) of *A. clarkae*, viewed from above. a, Nearly complete arch. b, c, d, Fragmentary arches (d in posterior aspect). Scale in mm.

FIGURE 11. The cervical vertebrae and scapula, as preserved, in the type specimen (QM F16788) of *A. clarkae*, in lateral view. c, Centrum (viewed obliquely from above). p, Prezygapophyses. pa, Parapophysis. s, Scapula. Scale in mm.

FIGURE 12. Dorsal osteoderms, *in situ,* of the type specimen (QM F16788) of *A. clarkae,* in dorsal view. Two complete osteoderms are indicated by arrows just at left of centre and at bottom-centre. Scale in mm.

affinities. Thus the semi-enclosed fourth mandibular tooth is probably a convergent feature.

Australosuchus clarkae shows some features that have been tentatively proposed as synapomorphies of an Australian Tertiary crocodile radiation (Willis *et al.* 1990). These include the lack of an anterior process of the palatine, the degree and sequence of tooth enlargement in the dentary and the presence of an overbite. The lesser development of an alveolar process on the premaxilla and maxilla and the palatal fenestrae being more posteriorly located than in other Australian crocodilians suggest that *A. clarkae* is a more plesiomorphic member of this group.

There is a striking resemblance between the anterior portion of the dentaries of *A. clarkae* and *B. darrowi* which suggests a close affinity between the two. However, they differ in the posterior extent of the mandibular symphysis. In *Baru* the symphysis extends to the level of the sixth or seventh alveolus while in *Australosuchus* it extends only to the level of the fourth or fifth alveolus.

Discussion

Australosuchus clarkae is a freshwater crocodilian of moderate size from the late Oligocene and early Miocene of central Australia. To date, it is the oldest described member of the Australian Tertiary radiation of crocodiles (Willis *et al.* 1990). It shows some features that suggest it may be the most plesiomorphic member of this group. *Australosuchus clarkae* is considered to be a generalised crocodilian, that is, it lacks features commonly associated with more specialised crocodilians such as longirostrine, ziphodont or brevirostrine characters.

As discussed briefly above, the Mampuwordu specimens obstensibly represent this species in late Pliocene or early Pleistocene time in the Lake Palankarinna area. However, cataloguing or collecting errors may be involved. While the possibility that this species remained largely unchanged from the late Oligocene to the Pleistocene could not be ruled out, such extreme morphological conservatism seems unlikely even in situations where environments persisted for long times. Unfortunately, without considerably more research, details of preservation cannot be reliably used to distinguish between specimens of the Mampuwordu deposit and those from the older Etadunna deposits (Archer, pers. comm.)

Material belonging to *A. clarkae* has been mentioned by other authors. Estes (1984)

commented that the only crocodilian material in a sample of fossils from Lake Palankarinna were small, unidentifiable teeth. Stirton *et al.* (1968) mentioned unidentifiable crocodilian remains from Lake Palankarinna. Molnar (1982) briefly mentioned the 'Etadunna' crocodilian suggesting that it may be related to a crocodilian from Murgon in south-east Queensland. Because there is no evidence of more than one crocodilian from Lake Palankarinna in the extensive collections of material examined in this study, it seems reasonable that crocodilian material mentioned by these authors can be attributed, at least tentatively, to *A. clarkae*.

Acknowledgments

We would like to thank Tom Rich, Neville Pledge and Gene Gaffney for the loan of material used in this study. Mike Archer collected the type specimen, critically read early drafts and finished manuscripts and offered advice about the biostratigraphy. Dick Tedford and Neville Pledge provided photographs of some specimens and L. Bierne produced all artwork. The Queensland Museum and an N. S. F. Grant to M. O. Woodburne provided support for the 1975 expeditions to Lake Palankarinna. A scholarship from the Dean of the Faculty of Biological and Behavioural Sciences, University of New South Wales, provided support for one of the authors (P. W.) during this study.

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MOLLUSC TYPE SPECIMENS IN THE SOUTH AUSTRALIAN MUSEUM. 4. GASTROPODA: MARGINELLIDAE

D. R. HEWISH & K. L. GOWLETT-HOLMES

HEWISH, D. R. & GOWLETT-HOLMES, K. L. 1991. Mollusc type specimens in the South Australian Museum. 4. Gastropoda: Marginellidae. *Rec. S. Aust. Mus.* 25(1): 57–70

The South Australian Museum collection of marginellid types is one of the most important collections of reference material for the Australian members of the family. The species represented originate mainly from Tasmania and southern and eastern Australia, plus two species from New Zealand, and one species each from Antarctica, Sri Lanka and Madeira. The collection contains primary type material, and some secondary types, of 27 species; a further 28 species are represented by secondary types.

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The Marginellidae is a family of mainly marine gastropods that is particularly well represented in Australia, and its members are especially abundant in southern Australian waters. Because of this, the Australian fauna occupies an important place in the taxonomy of the family as a whole. The majority of Australian species have been named during this century, and the primary types of most of these are held in collections of Australian museums.

The earliest marginellid type material in the South Australian Museum collection is from the work of Prof. R. Tate between 1878 and 1901. Tate described species collected by himself and by W. L. May from South Australia and Tasmania (Tate 1878; Tate & May 1900, 1901). As most of Tate's species descriptions were not accompanied by figures, these species are illustrated here, with the exception of those which were illustrated by Tate & May (1901).

A large number of secondary types and some primary types of Marginellidae in the South Australian Museum are from the collection of W. L. May, acquired by Sir Joseph Verco and presented to the museum in 1929. The May Collection contained secondary types of all of the species that May had described from Tasmania, plus the types of some species described by May's contemporaries from within Australia and from overseas.

A later series of marginellid types resulted from the work of Cotton (1944, 1949), who described several new species from southern and western Australia, mostly from material previously collected by May and Verco early this century. Cotton's types have never been adequately illustrated, as the figures accompanying the original descriptions were of poor quality and, in some cases, misleading. Figures of types of all of Cotton's species have therefore been included here. Also in the collection are specimens of several species of *Marginella* described by C. Laseron from New South Wales, which come from the type localities, and were donated to the South Australian Museum by Laseron. These specimens are believed to be from the type series, and are regarded here as syntypes.

Since Laseron (1957) little of consequence has been published on Australian Marginellidae, and the type material of only one species, *Marginella ealesae* Powell, 1958 (holotype), has been added to the collection.

As a result of the above research, the type collection in the South Australian Museum is very representative of the marginellid fauna of southern Australia and contains a very extensive range of secondary types.

All species listed in this paper were originally described under the genus *Marginella* Lamarck, 1799, but have subsequently been placed in other genera. The generic classification of the Australian Marginellidae has been neglected since Laseron (1957), and is in need of revision. The most recently published revision of genera for this family is by Coan (1965), and this scheme, although outdated, has been followed here, with modifications as indicated in the text. Other modifications are the use of *Mesoginella* Laseron, 1957 for species placed previously in *Sinuginella* Laseron, 1957, following Coovert (1988), and the use of *Austroginella* Laseron, 1957, *Alaginella* Laseron, 1957 and *Protoginella* Laseron, 1957 as valid genera, not subgenera of *Marginella.* This is considered necessary because species of *Marginella* lack radulae, while those of the above Australian genera have well developed radulae (D.R.H., unpublished

results and see Coovert (1989) for review). It should be noted that a considerable amount of further work is necessary before the status of many generic and subgeneric groups can be established, and it is probable that extensive changes will be made in the future. No comprehensive revision of the Australian Marginellidae at the species level has ever been undertaken, and the species level taxonomy obviously requires considerable updating. In the following list, species are listed alphabetically according to their names at the time of description, followed by the original citation, the current generic placement (Coan 1965) and current species allocation as determined by the authors.

The following abbreviations are used in the text. AIM = Auckland Institute and Museum, New Zealand; AM = Australian Museum, Sydney; BANZARE = British, Australian and New Zealand Antarctic Research Expedition, 1929–1931; BMNH = British Museum (Natural History), London; NMV = Museum of Victoria, Melbourne; N.S.W. = New South Wales; N.Z. = New Zealand; NZGS = New Zealand Geological Survey, Lower Hutt; S.A. = South Australia; SAM = South Australian Museum, Adelaide; Tas. = Tasmania; TM = Tasmanian Museum and Art Gallery, Hobart; Vic. = Victoria; W.A. = Western Australia.

Family **MARGINELLIDAE**

Subfamily **Marginellinae**

Genus ***Marginella*** Lamarck, 1799

Marginella albida Tate, 1878
Trans. Proc. Rep. Phil. Soc. Adel. **1**: 87.
= *Volvarina (Haloginella) vincentiana* (Cotton, 1944) *(q.v.)* new name for *M. albida* Tate, 1878.
Lectotype: D13519, adult specimen, in shell sand, Marino, near Adelaide, S.A., collected by R. Tate, date of collection unknown. (Lectotype selected here.) (Figs 1A-B).
Paralectotypes: D18633, 7 specimens (2 immature), with same collection data as lectotype.
Note: We have selected the lectotype (D13519) from the lot labelled '*M. albida* Tate, Tate's type & co-types' from Marino, S.A., the first locality listed in the original description by Tate (1878), and have designated the remainder of this lot (D18633) as paralectotypes. The specimen selected as lectotype was first separated and registered by B. C. Cotton in 1938 as the holotype of this species, as this specimen corresponded most closely to the measurements given by Tate (1878). However, as Tate (1878) did not designate a holotype, we have selected this specimen as the lectotype (ICZN Recommendation 73F). The 'two examples' mentioned by Tate (1878) most probably refer to the number of specimens from Aldinga, S.A., the last locality listed in the description.

Marginella albomaculata May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 382, pl. 13, fig. 2.
= *Persicula concamerata* (May, 1918) *(q.v.)* new name for *M. albomaculata* May, 1911.
Paratype: D15790, adult specimen, in kelp root, Frederick Henry Bay, Tas., collected by W. L. May, date of collection unknown.
Note: Neither this specimen nor the holotype (TM E627/7968) were alive when collected. The shell surface of the paratype is slightly eroded and there is no trace of the pattern of white spots present on the holotype. This species was placed in the genus *Epiginella* by Laseron (1957), which is now considered to be a subgenus of *Crithe* Gould, 1860 (Coan 1965). However, the shell possesses a colour pattern which precludes its inclusion in that genus and suggests that it is more correctly placed in *Persicula*.

Marginella altilabra May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 383, pl. 13, fig. 3.
= *Mesoginella altilabra* (May, 1911).
Paratypes: D15789, 15 adult specimens (1 damaged), dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D16086, 2 adult specimens, with same collection data as D15789.
Note: Holotype in TM (E616/7915).

Marginella auriculata May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 85, pl. 1, fig. 6.
= *Cystiscus tomlinianus* (May, 1918) *(q.v.)* new name for *M. auriculata* May, 1916.
Paratypes: D15811, 23 adult specimens (3 damaged), dredged in 73 m (40 fm), off Thouin Bay, Tas., collected by W. L. May, date of collection unknown. D16084, 2 adult specimens, with same collection data as D15811.
Note: Holotype in TM (E677/8018), badly broken.

Marginella baca Cotton, 1949
Rec. S. Aust. Mus. 9(2): 200, pl. 20.
= *Kogomea eucla* (Cotton, 1944) **new synonymy.**
Holotype: D14227, adult specimen, dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. (Figs 1C-D).
Note: It can be seen from the figures that this shell and the type of *Kogomea eucla* (Figs 1K-L) are virtually identical and there are no distinctive features that can be used to separate the two forms. We therefore consider *M. baca* to be a junior synonym of *K. eucla*. This species is extremely similar to *K. diplostrepta* (May, 1916), but is approximately half the size of the latter, so a more

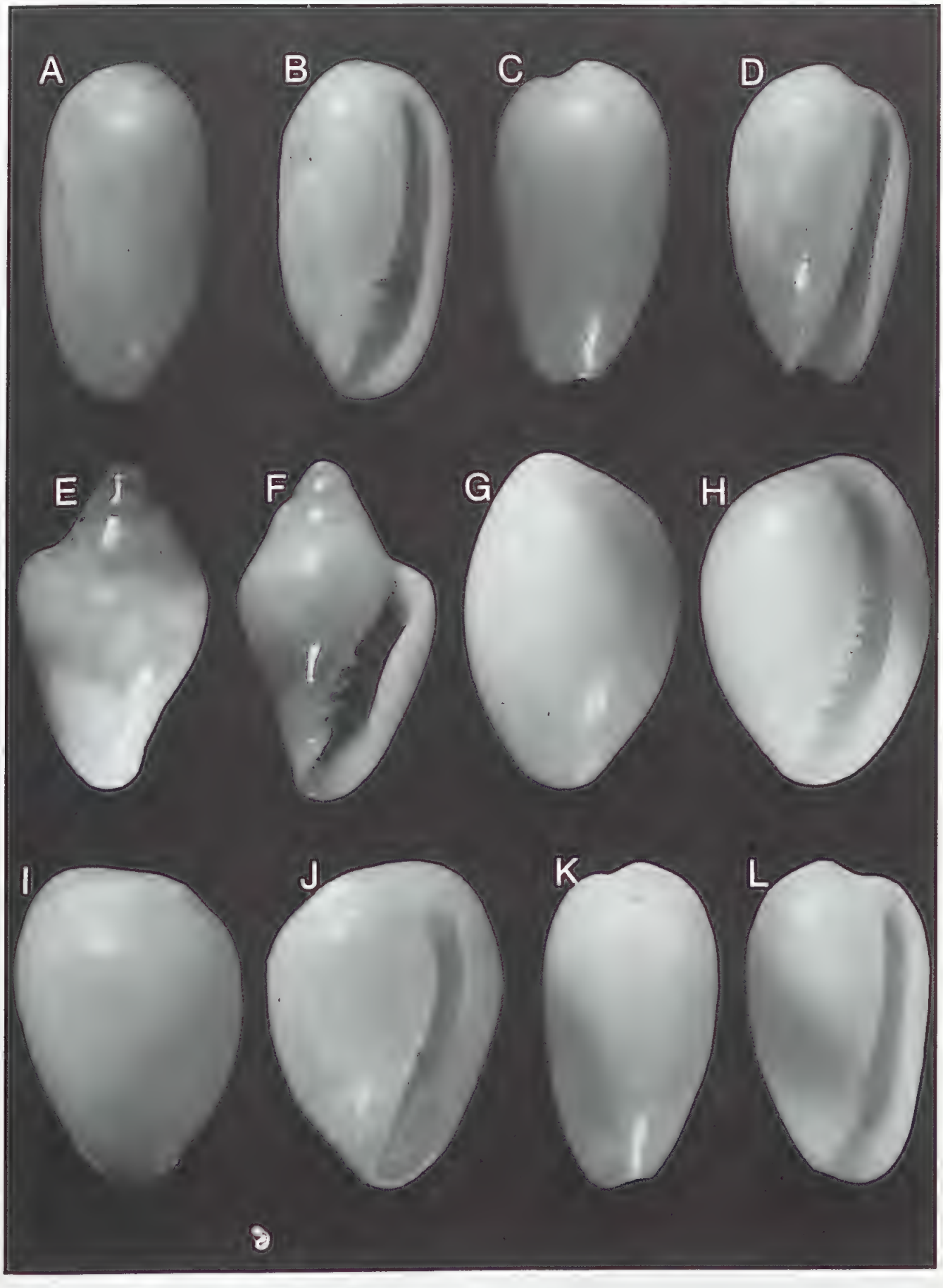

FIGURE 1. A-B: *Marginella albida* Tate, 1878 (= *M. vincentiana* Cotton, 1944), lectotype, SAM D13519, × 9.9. C-D: *M. baca* Cotton, 1949, holotype, SAM D14227, × 11.8. E-F: *M. borda* Cotton, 1944, holotype, SAM D14988, × 10.8. G-H: *M. cymbalum* Tate, 1878, adult syntype, SAM D13521, × 9.3. I-J: *M. denticulata* Tate, 1878 (= *M. elliottae* Cotton, 1944), syntype, SAM D14501, × 22.3. K-L: *M. eucla* Cotton, 1944, holotype, SAM D14985, × 11.2.

extensive investigation is required to establish their relationship. Type unique.

Marginella binivitta Laseron, 1948
Rec. Aust. Mus. **22**(1): 39, pl. 5, fig. 11.
= *Mesoginella binivitta* (Laseron, 1948).
Syntypes: D14235, 3 adult specimens, dredged dead in sandy mud in 55–64 m (30–35 fm), Crookhaven, N.S.W., collected by C. F. Laseron, date of collection unknown.
Note: These specimens were obtained from Laseron, and are believed to be from the type series. This species may be synonymous with *Mesoginella olivella* (Reeve, 1865), but a more extensive investigation is required. Other syntypes in AM (C103363).

Marginella biplicata Tate & May, 1900.
Trans. Proc. R. Soc. S. Aust. **24**: 92.
= *Kogomea diplostrepta* (May, 1916) *(q.v.)* new name for *M. biplicata* Tate & May, 1900.
Syntype: D18635, immature specimen, dredged in 44 m (24 fm), Port Esperance, Tas., collected by W. L. May, date of collection unknown.
Note: This species was figured by Tate & May (1901). The other syntype is in TM (E634/7975), badly damaged.

Marginella borda Cotton, 1944
S. Aust. Nat. **22**: 16, fig. 33.
= *Alaginella borda* (Cotton, 1944).
Holotype: D14988, adult specimen with dried animal, dredged in 100 m (55 fm), off Cape Borda, S.A., collected by J. C. Verco, January 1905. (Figs 1E-F).
Paratypes: D18645, 2 adult specimens, dredged dead in 90 m (49 fm), off Beachport, S.A., collected by J. C. Verco, date of collection unknown. D18646, 2 adult specimens (1 damaged), dredged dead in 238 m (130 fm), off Cape Jaffa, S.A., collected by J. C. Verco, date of collection unknown. D18747, 4 adult specimens (1 damaged), dredged dead in 82 m (45 fm), east of North Neptune Island, S.A., collected by J. C. Verco, date of collection unknown. D18648, 1 damaged adult specimen, dredged dead in 64 m (35 fm), King George Sound, W.A., collected by J. C. Verco, date of collection unknown. D18649, 2 adult specimens, dead collected, in beach sand, Hopetoun, W.A., collected by J. C. Verco, date of collection unknown.

Marginella caducocincta May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 88, pl. 2, fig. 11.
= *Mesoginella caducocincta* (May, 1916).
Paratypes: D15794, 16 adult specimens, dredged dead in 73 m (40 fm), off Thouin Bay, Tas., collected by W. L. May, date of collection unknown. D16083, 7 adult specimens, with same collection data as D15794.
Note: Holotype in TM (E623/7964).

Marginella cairoma Brookes, 1924
Trans. Proc. N.Z. Inst. **55**: 154, pl. 7, figs 4–5.
= *Dentimargo cairoma* (Brookes, 1924).
Paratypes: D9447, 6 specimens (1 immature), Taipa, Doubtless Bay, N.Z., collected by A. E. Brookes, date of collection unknown.
Note: Holotype in AIM (TM1277).

Marginella cartwrighti Sowerby, 1915
Proc. Malac. Soc. Lond. **11**(4): 214, text fig.
= *Granulina cartwrighti* (Sowerby, 1915).
Syntypes: D9460, 2 adult specimens, Trincomalee, Ceylon (Sri Lanka), collector and date of collection unknown.
Note: Two other syntypes in BMNH (1919.12.31.45–46).

Marginella columnaria Hedley & May, 1908
Rec. Aust. Mus. **7**: 120, pl. 23, fig. 19.
= *Pillarginella columnaria* (Hedley & May, 1908).
Paratypes: D15798, 6 adult specimens (1 damaged), dredged in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907.
Note: Although Coan (1965) synonymised *Pillarginella* Gabriel, 1962 with *Haloginella* Laseron, 1957 (as a subgenus of *Volvarina* Hinds, 1844), examination of the radula of this species, which is the type species of the former, by one of us (DRH), suggests that *Pillarginella* is distinct from *Volvarina*. Holotype in AM (C28936), other paratypes in AM (C163392), TM (E625/7966), NMV (F30598) and BMNH.

Marginella concamerata May, 1918
Pap. Proc. R. Soc. Tas. **for 1917**: 104.
= *Persicula concamerata* (May, 1918).
Paratype: D15790, adult specimen, in kelp root, Frederick Henry Bay, Tas., collected by W. L. May, date of collection unknown.
Note: New name for *Marginella albomaculata* May, 1911 (*non* Schlüter, 1838), and therefore based on the same type series. Holotype in TM (E627/7968).

Marginella connectans May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 387, pl. 14, fig. 11.
= *Cystiscus connectans* (May, 1911).
Paratypes: D15795, 9 adult specimens (3 damaged), dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D16082, 1 adult specimen, with same collection data as D15795.
Note: Holotype in TM (E628/7969).

Marginella (Volvaria) consanguinea Smith, 1890
Proc. Zool. Soc. Lond. **60**: 266, pl. 23, fig. 11.
= *Cystiscus consanguineus* (Smith, 1890).
Syntypes: D17540, 2 damaged adult specimens, from St Helena, collector and date of collection unknown.
Note: From the May Collection. Other syntypes in BMNH.

Marginella consobrina May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 387, pl. 14, fig. 10.
= *Mesoginella consobrina* (May, 1911).
Paratypes: D15792, 2 adult specimens, dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907.
Note: Holotype in TM (E630/7971).

Marginella cratericula Tate & May, 1900
Trans. Proc. R. Soc. S. Aust. **24**: 91.
= *Cystiscus cratericulus* (Tate & May, 1900).
Syntype: D18634, adult specimen with dried animal, dredged in 18 m (10 fm), D'Entrecasteaux Channel, Tas., collected by W. L. May, date of collection unknown.
Note: This species was figured by Tate & May (1901). One other syntype in TM (E631/7972).

Marginella cylichnella May, 1918
Pap. Proc. R. Soc. Tas. **for 1917**: 104.
= *Balanetta (Ovaginella) cylichnella* (May, 1918).
Paratypes: D15793, 8 adult specimens (2 damaged), dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D18636, 1 adult specimen, with same collection data as D15793.
Note: New name for *Marginella microscopica* May, 1911 (*non* Tapparone Canefri, 1875), and therefore based on the same type series. Holotype in TM (E632/7973), broken.

Marginella cymbalum Tate, 1878
Trans. Proc. Rep. Phil. Soc. Adel. **1**: 86.
= *Cystiscus cymbalum* (Tate, 1878).
Syntypes: D13521, 2 specimens (1 immature), in beach sand, Aldinga Bay, near Adelaide, S.A., collected by R. Tate, date of collection unknown. (Figs 1G–H).
Note: Other syntypes in BMNH (1879.10.28.7).

Marginella denticulata Tate, 1878.
Trans. Proc. Rep. Phil. Soc. Adel. **1**: 87.
= *Granulina elliottae* (Cotton, 1944) *(q.v.)* new name for *M. denticulata* Tate, 1878.
Syntypes: D14501, 7 adult specimens (2 damaged), in beach sand, Wauraltie (Port Victoria), Yorke Peninsula, S.A., collected by R. Tate, date of collection unknown. (Figs 1I–J).
Note: The type description only mentions three specimens, and as all the specimens in D14501 are of approximately equal size and form, it is impossible to isolate the actual syntypes. Therefore the status of the entire lot is questionable.

Marginella dentiens May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 384, pl. 13, fig. 6.
= *Volvarinella dentiens* (May, 1911).
Paratypes: D15791, 7 adult specimens (2 damaged), dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., 18.xii.1907, and dredged dead in 146 m (80 fm), 10 miles east of Schouten Island, Tas., date of collection unknown, all collected by W. L. May.
Note: Holotype in TM (E633/7974).

Marginella diplostreptus May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 76.
= *Kogomea diplostrepta* (May, 1916).
Syntype: D18635, immature specimen, dredged in 44 m (24 fm), Port Esperance, Tas., collected by W. L. May, date of collection unknown.
Note: New name for *Marginella biplicata* Tate & May, 1900 (*non* Krauss, 1852), and therefore based on the same type series. This species was figured by Tate & May (1901) as *M. biplicata*. One other syntype in TM (E634/7975), badly damaged.

Marginella ealesae Powell, 1958
BANZARE Rep. Ser. B, **6**(9): 200, text fig. B1.
=*Marginella? ealesae* Powell, 1958.
Holotype: D15505, possibly immature specimen with dried animal, dredged in 300 m, BANZARE Stn 39, off Enderby Land, Antarctica, (66°30′S, 49°45′E), collected by BANZARE, 17.i.1930.
Note: As this species comes from a population which has received very little study and which may not be contiguous with other faunas, its generic status cannot be accurately assigned on the basis of shell characters alone. Only examination of the radula will allow the genus to be assigned accurately.

Marginella elliottae Cotton, 1944
S. Aust. Nat. **22**: 13.
= *Granulina elliottae* (Cotton, 1944).
Syntypes: D14501, 7 adult specimens (2 damaged), in beach sand, Wauraltie (Port Victoria), Yorke Peninsula, S.A., collected by R. Tate, date of collection unknown. (Figs 1I–J).
Note: New name for *Marginella denticulata* Tate, 1878, (*non* Link, 1807, *nec* Conrad, 1830), and therefore based on the same type series. See note under that species concerning the status of these specimens.

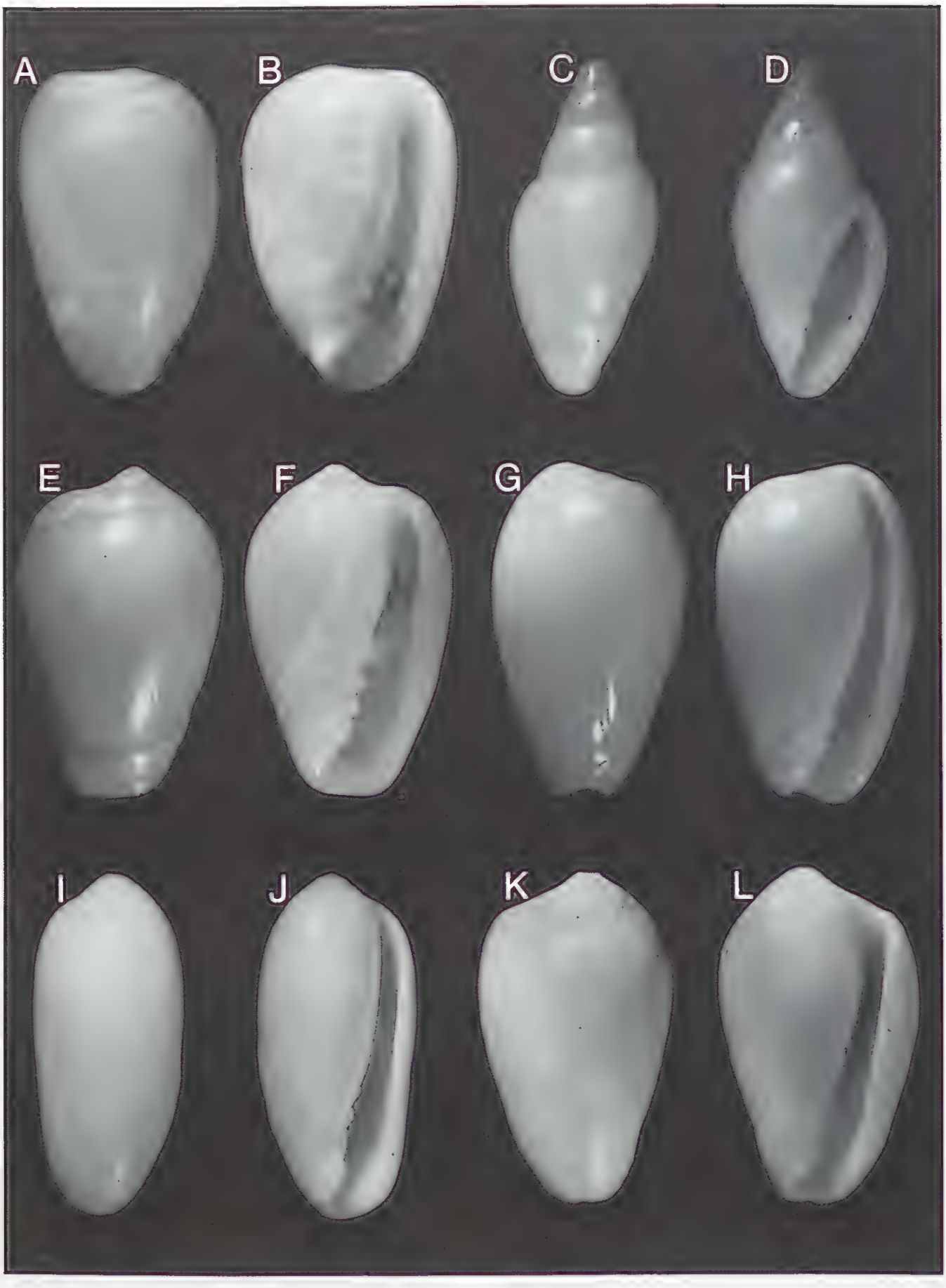

FIGURE 2. A-B: *Marginella erma* Cotton, 1944, holotype, SAM D14986, × 18.5. C-D: *M. jaffa* Cotton, 1944, holotype, SAM D14982 × 8.7. E-F: *M. leia* Cotton, 1944, holotype, SAM D14984, × 6.4. G-H: *M. newmanae* Cotton, 1949, holotype, SAM D14229, × 5.6. I-J: *M. occidua* Cotton, 1944, holotype, SAM D14987, × 4.4. K-L: *M. patria* Cotton, 1949, holotype, SAM D14228, × 13.4.

Marginella erma Cotton, 1944
S. Aust. Nat. **22**: 15.
= *Cystiscus angasi* (Crosse, 1870) **new synonymy.**
Holotype: D14986, damaged adult specimen, dredged in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. (Figs 2A-B).
Note: This species was inadequately described and figured by Cotton (1944). It is apparently a minor variant of *Cystiscus angasi*, which is a species that exhibits considerable variability of shell shape and has a number of synonyms (Laseron 1957). Type unique.

Marginella eucla Cotton, 1944
S. Aust. Nat. **22**: 12, fig. 24.
= *Kogomea eucla* (Cotton, 1944).
Holotype: D14985, adult specimen, dredged dead in 146 m (80 fm), off Eucla, W.A., collected by J. C. Verco, March 1912. (Figs 1K-L).
Paratypes: D15915, 4 adult specimens, with same collection data as holotype. D18667, 58 specimens (21 damaged, 4 immature), dredged dead in 148 m (81 fm), 80 miles west of Eucla, W.A., collected by J. C. Verco, March 1912. D18668, 19 specimens (3 damaged, 4 immature), dredged dead in 146–220 m (80–120 fm), west of Eucla, W.A., collected by J. C. Verco, March 1912. D18669, 9 adult specimens (2 damaged), in beach sand, Hopetoun, W.A., collected by J. C. Verco, date of collection unknown. D18670, 24 specimens (5 damaged, 4 immature), dredged dead in 73 m (40 fm), off Beachport, S.A., collected by J. C. Verco, date of collection unknown. D18671, 2 adult specimens, dredged dead in 90 m (49 fm), other collection data same as D18670. D18672, 25 specimens (4 damaged, 7 immature), dredged dead in 201 m (110 fm), other collection data same as D18670. D18673, 24 specimens (4 damaged, 1 immature), dredged dead in 274 m (150 fm), other collection data same as D18670. D18674, 15 specimens (1 damaged, 6 immature), dredged dead in 366 m (200 fm), other collection data same as D18670. D18675, 33 specimens (5 damaged, 9 immature), dredged dead in 164 m (90 fm), off Cape Jaffa, collected by J. C. Verco, date of collection unknown. D18676, 16 specimens (4 damaged, 1 immature), dredged dead in 238 m (130 fm), other collection details same as D18675. D18677, 41 specimens (11 damaged, 3 immature), dredged dead in 100 m (55 fm), off Cape Borda, Kangaroo Island, S.A., collected by J. C. Verco, date of collection unknown. D18678, 30 specimens (2 damaged, 12 immature), dredged dead in 113 m (62 fm), north-west of Cape Borda, Kangaroo Island, S.A., collected by J. C. Verco, date of collection unknown. D18679, 1 adult specimen, dredged dead in 36 m (20 fm), off Newland Head, S.A., collected by J. C. Verco, date of collection unknown. D18680, 6 adult specimens (3 damaged), dredged dead in 27–36 m (15–20 fm), off St Francis Island, Nuyts Archipelago, S.A., collected by J. C. Verco, date of collection unknown.
Note: *Marginella baca* Cotton, 1949 is a junior synonym.

Marginella freycineti May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 86, pl. 2, fig. 9.
= *Cystiscus freycineti* (May, 1916).
Paratypes: D16174, 22 adult specimens, dredged dead in 73 m (40 fm), Thouin Bay, Tas., collected by W. L. May, date of collection unknown. D16088, 3 adult specimens, from Tas., collected by W. L. May, date of collection unknown.
Note: This species may be a form of *Cystiscus angasi* (Crosse, 1870). Holotype in TM (E636/7977).

Marginella gabrieli May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 386, pl. 13, fig. 9.
= *Volvarinella? gabrieli* (May, 1911).
Paratypes: D15805, 8 adult specimens (1 with dried animal), dredged in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D16077, 2 adult specimens, from Tas., collected by W. L. May, date of collection unknown.
Note: The generic placement of this species is problematical and cannot be resolved on the basis of shell characters alone. Holotype in TM (E642/7983).

Marginella gatliffi May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 385, pl. 13, fig. 8.
= *Protoginella gatliffi* (May, 1911).
Paratypes: D15987, 47 adult specimens (9 damaged), dredged dead off Schouten Island, Tas., collected by W. L. May, date of collection unknown. D16805, 2 adult specimens, dredged dead in 73 m (40 fm), off Schouten Island, Tas., collected by W. L. May, 27.iii.1910.
Note: Holotype in TM (E643/7984).

Marginella georgeana May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 88, pl. 3, fig. 13.
= *Austroginella georgeana* (May, 1916).
Paratypes: D15803, 3 specimens (1 immature), dredged dead in 27 m (15 fm), near George III Reef, below Southport, Tas., collected by W. L. May, date of collection unknown.
Note: Laseron (1957) placed this species in his genus *Plicaginella*, which has been synonymised with *Austroginella* by Coovert (1988) on the basis of radular morphology. Holotype in TM (E645/7985).

Marginella gracilis May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 383, pl. 13, fig. 4.
= *Volvarinella maugeana* (Hedley, 1915) *(q.v.)* new name for *M. gracilis* May, 1911.
Paratypes: D15815, 9 adult specimens, dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D16087, 2 adult specimens, with same collection data as D15815.
Note: Holotype in TM (E657/7998).

Marginella hedleyi May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 381, pl. 13, fig. 1.
= *Volvarina (Haloginella) hedleyi* (May, 1911).
Paratypes: D15799, 11 specimens (5 immature, 3 adult and 1 immature with dried animals), dredged in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D16076, 2 adult specimens, dead collected, with same collection data as D15799.
Note: Holotype in TM (E646/7987).

Marginella inaequidens May, 1913
Pap. Proc. R. Soc. Tas. **for 1912**: 44, pl. 2, fig. 1.
= *Cystiscus inaequidens* (May, 1913).
Paratypes: D15804, 16 adult specimens (1 damaged), dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., 18.xii.1907, and dredged dead in 73 m (40 fm), off Schouten Island, Tas., 27.iii.1910, all collected by W. L. May. D16078, 3 specimens (1 immature, 1 damaged), dredged dead in 183 m (100 fm), off Cape Pillar, Tas., collected by W. L. May, 18.xii.1907.
Note: Holotype in TM (E647/7988), badly broken.

Marginella incerta May, 1920
Pap. Proc. R. Soc. Tas. **for 1919**: 59, pl. 16, fig. 8.
= *Cystiscus incertus* (May, 1920).
Paratypes: D15806, 14 adult specimens (2 damaged), dredged dead in 73 m (40 fm), Thouin Bay, Tas., collected by W. L. May, date of collection unknown.
Note: This species is closely related to *Cystiscus angasi* (Crosse, 1870). Holotype in TM (E649/7990).

Marginella indiscreta May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 388, pl. 14, fig. 12.
= *Cystiscus indiscretus* (May, 1911).
Paratypes: D15813, 5 adult specimens (1 damaged), dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D16080, 1 adult specimen, with same collection data as D15813.
Note: Holotype in TM (E651/7992).

Marginella jaffa Cotton, 1944
S. Aust. Nat. **22**: 11, fig. 13.
= *Volvarinella jaffa* (Cotton, 1944).
Holotype: D14982, adult specimen, dredged dead in 238 m (130 fm), off Cape Jaffa, S.A. collected by J. C. Verco, date of collection unknown. (Figs 2C-D).
Paratypes: D15914, 4 adult specimens, with same collection data as holotype. D18655, 11 specimens (1 damaged, 1 immature), dredged dead in 201 m (110 fm), off Beachport, S.A., collected by J. C. Verco, date of collection unknown. D18656, 11 specimens (1 damaged, 4 immature), dredged dead in 274 m (150 fm), other collection data same as D18655. D18657, 14 specimens (2 damaged, 3 immature), dredged dead in 366 m (200 fm), other collection data same as D18655. D18658, 1 damaged adult specimen, dredged dead in 100 m (55 fm), off Cape Borda, Kangaroo Island, S.A., collected by J. C. Verco, date of collection unknown. D18659, 20 specimens (5 damaged, 5 immature), dredged dead in 190 m (104 fm), 35 miles south-west of Neptune Islands, S.A., collected by J. C. Verco, date of collection unknown. D18660, 18 specimens (8 damaged, 7 immature), dredged dead in 148 m (81 fm), 80 miles west of Eucla, W.A., collected by J. C. Verco, March 1912. D18661, 1 adult specimen, dead collected, in beach sand, Hopetoun, W.A., collected by J. C. Verco, date of collection unknown.
Note: This species is very similar to *Volvarinella cuneata* (Laseron, 1948).

Marginella leia Cotton, 1944
S. Aust. Nat. **22**: 10, fig. 11.
= *Mesoginella turbinata* (Sowerby, 1846) **new synonymy.**
Holotype: D14984, adult specimen, dredged dead in 274 m (150 fm), off Beachport, S.A., collected by J. C. Verco, date of collection unknown. (Figs 2E-F).
Paratypes: D18653, 7 adult specimens, with same collection data as holotype. D18651, 5 adult specimens, dredged dead in 73 m (40 fm), other collection data same as holotype. D18652, 17 specimens (6 damaged, 1 immature), dredged dead in 201 m (110 fm), other collection data same as holotype. D18654, 6 adult specimens (1 damaged), dredged dead in 366 m (200 fm), other collection data same as holotype. D18650, 3 specimens (2 immature), dredged dead in 113 m (62 fm), off Cape Borda, Kangaroo Island, S.A., collected by J. C. Verco, date of collection unknown.
Note: The original illustration of this species was misleading as it did not show an anterior canal which is very well developed in the holotype. The types are heterogeneous in form and appear to be minor variants of *Mesoginella turbinata*, so we regard *M. leia* as a junior synonym of the latter. This change renders invalid the genus *Spiroginella* Laseron, 1957.

Marginella lodderae May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 384, pl. 13, fig. 5.
= *Volvarinella lodderae* (May, 1911).
Paratype: D15814, damaged adult specimen, dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907.
Note: This specimen was labelled by Verco 'Co-Type but somewhat uncertain'. As this specimen is from the May Collection, and was collected at the same time and locality as the type, we believe it is a valid paratype. Holotype in TM (E656/7997).

Marginella (Glabella) lurida Suter, 1909
Proc. Malac. Soc. Lond. 8(3): 183, pl. 7, fig. 14.
= *Volvarina lurida* (Suter, 1909).
Paralectotypes: D9474, 2 adult specimens (1 broken), dredged dead in 27 m (15 fm), Foveaux Strait, N.Z., collector and date of collection unknown.
Note: Lectotype in NZGS (TM1086), selected by Boreham (1959).

Marginella malina Hedley, 1915
Proc. Linn. Soc. N.S.W. 39(4): 725, pl. 82, fig. 65.
= *Triginella malina* (Hedley, 1915).
Paratypes: D16109, 6 specimens (1 immature, 2 broken), dredged dead in 146 m (80 fm), 22 miles east of Narrabeen, N.S.W., collected by W. A. Haswell, H.M.C.S. 'Miner', 7.vi.1906.
Note: Holotype in AM (C25936), other paratypes in AM (C18242, C163384) and BMNH (1915.12.31.114–117).

Marginella maugeana Hedley, 1915
Proc. Linn. Soc. N.S.W. 39(4): 727.
= *Volvarinella maugeana* (Hedley, 1915).
Paratypes: D15815, 9 adult specimens, dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D16087, 2 adult specimens, with same collection data as D15815.
Note: New name for *Marginella gracilis* May, 1911 (*non* C. B. Adams, 1852), and therefore based on the same type series. Holotype in TM (E657/7998).

Marginella mayii Tate in Tate & May, 1900
Trans. Proc. R. Soc. S. Aust. 24: 93.
= *Volvarinella mayii* (Tate, 1900).
Syntypes: D13523, 1 adult specimen, dead collected, Frederick Henry Bay, Tas., collected by W. L. May, date of collection unknown. D16131, 1 broken specimen, dead collected, from Tas., collected by W. L. May, date of collection unknown.
Note: This species was figured by Tate & May (1901). Other syntypes in TM (E659/8000) and BMNH (1912.6.23.1–2).

Marginella microscopica May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 389, pl. 14, fig. 13.
= *Balanetta (Ovaginella) cylichnella* (May, 1918) *(q.v.)* new name for *M. microscopica* May, 1911.
Paratypes: D15793, 8 adult specimens (2 broken), dredged dead in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D18636, 1 adult specimen, with same collection data as D15793.
Note: The generic affinities of this species are problematical and examination of the animal is necessary before accurate assignment can be made. Holotype in TM (E632/7973), broken.

Marginella multidentata May, 1920
Pap. Proc. R. Soc. Tas. **for 1919**: 59, pl. 16, fig. 7.
= *Cystiscus multidentatus* (May, 1920).
Paratype: D15802, adult specimen, dredged in 18 m (10 fm), off Gordon, D'Entrecasteaux Channel, Tas., collected by W. L. May, December 1918.
Note: Holotype in TM (E662/8003).

Marginella newmanae Cotton, 1949
Rec. S. Aust. Mus. 9(2): 199, pl. 20.
= *Persicula pulchella* (Kiener, 1834) **new synonymy.**
Holotype: D14229, adult specimen, Esperance, W.A., collector and date of collection unknown. (Figs 2G-H).
Note: Close examination shows the presence of a faint pattern of orange zig-zag lines not mentioned in the type description. The holotype and the specimens listed and labelled *M. newmanae* by Cotton (1949) (SAM D18727–33) encompass all the forms of *Persicula pulchella* found in southern Australia, and we therefore regard *M. newmanae* as a junior synonym of *P. pulchella*. This species was placed in the genus *Epiginella* by Laseron (1957).

Marginella obesula May, 1920
Pap. Proc. R. Soc. Tas. **for 1919**: 58, pl. 14, fig. 5.
= *Cystiscus obesulus* (May, 1920).
Paratypes: D15809, 7 adult specimens, in kelp rhizophores, Frederick Henry Bay, Tas., collected by W. L. May, date of collection unknown.
Note: This species is very closely related to *Cystiscus angasi* (Crosse, 1870) and can only be distinguished from that species by the distinctive orange and brown colours of the living animal as described by May (1920). Of the SAM types, four were dead when collected and their assignment must be considered doubtful. Of the remainder, definite traces of the characteristic colours of the animal can be seen through the shell of one specimen and it is certainly this species. The animal remains in the other two have deteriorated to the stage where it is impossible to conclusively identify the species,

FIGURE 3. A-B: *Marginella pattisoni* Cotton, 1944, holotype, SAM D14983, × 5.3. C-D: *M. sica* Cotton, 1949, holotype, SAM D14230, × 10.0. E-F: *M. subbulbosa* Tate, 1878, syntype, SAM D13520, × 13.3. G-H: *M. vercoi* May, 1911, paratype, SAM D15816, × 7.8. I-J: *M. weedingi* Cotton, 1944, holotype, SAM D14989, × 7.8.

but it must be assumed that May's original identification was correct. More detailed taxonomic work is necessary to establish the validity of this species. Holotype in TM (E667/8008).

Marginella occidua Cotton, 1944
S. Aust. Nat. **22**: 15, fig. 24.
= *Volvarina (Haloginella) occidua* (Cotton, 1944).
Holotype: D14987, adult specimen, Albany, W.A., collector and date of collection unknown. (Figs 2I-J).
Paratypes: D18681, 2 adult specimens, dead collected, Rottnest Island, W.A., collector and date of collection unknown. D18682, 1 immature specimen, dredged dead in 40 m (22 fm), off Bunbury, W.A., collected by J. C. Verco, date of collection unknown. D18683, 8 specimens (3 immature), dredged dead in 64 m (35 fm), off Hopetoun, W.A., collected by J. C. Verco, date of collection unknown. D18684, 18 adult specimens (2 damaged), dead collected, Albany, collected by W. G. Torr, date of collection unknown.
Note: The paratype lots contain specimens of two distinct spire and columellar plication morphologies. As shell sizes and colour patterns are the same throughout, examination of the animals is necessary to establish the status of the forms.

Marginella patria Cotton, 1949
Rec. S. Aust. Mus. 9(2): 201, pl. 20.
= *Mesoginella patria* (Cotton, 1949).
Holotype: D14228, adult specimen, dredged dead in 64 m (35 fm), off Hopetoun, W.A., collected by J. C. Verco, date of collection unknown. (Figs 2K-L).
Note: Laseron (1957) placed this species in the genus *Kogomea* Habe, 1951. However, some important shell features, notably the form of the columellar plications and labial dentition, do not correspond with those of that genus.

Marginella pattisoni Cotton, 1944
S. Aust. Nat. **22**: 11, fig. 10.
= *Mesoginella turbinata* (Sowerby, 1846) **new synonymy.**
Holotype: D14983, adult specimen, dead collected, Encounter Bay, S.A., collected by J. C. Verco, date of collection unknown. (Figs 3A-B).
Paratypes: D18862, 4 adult specimens, dredged live in 48 m (26 fm), 38 miles south-east of Newland Head, S.A., collected by J. C. Verco, date of collection unknown. D18663, 1 adult specimen, dead collected, Guichen Bay, S.A., collected by J. C. Verco, date of collection unknown. D18664, 43 specimens (19 damaged, 6 immature), in beach sand, Aldinga, near Adelaide, S.A., collector and date of collection unknown. D18665, 6 adult specimens, dead collected, Royston Head, Yorke Peninsula, S.A., collected by E. H. Matthews, date of collection unknown. D18666, 1 adult specimen, live collected, MacDonnell Bay, S.A., collected by W. G. Torr, date of collection unknown.
Note: The shell characters of this species are within the normal range of variability observed in populations of *Mesoginella turbinata*, and we consider it to be merely a broad variant of that species.

Marginella praetermissa May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 87, pl. 2, fig. 12.
= *Austroginella praetermissa* (May, 1916).
Paratypes: D15808, 3 adult specimens, from Tas., collector and date of collection unknown.
Note: Laseron (1957) placed this species in his genus *Plicaginella*, which has been synonymised with *Austroginella* by Coovert (1988) on the basis of radular morphology. Holotype in TM (E670/8011).

Marginella procella May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 87, pl. 2, fig. 10.
= *Mesoginella olivella* (Reeve, 1865).
Paratypes: D15810, 4 specimens (1 immature), dredged dead in 73 m (40 fm), off Schouten Island, Tas., collected by W. L. May, 27.iii.1910.
Note: May synonymised this species with *M. infelix* Jousseaume, and subsequently, *M. olivella* (see Laseron 1948). These two species have been considered to be synonymous, but the shells of *M. procella* and *M. infelix* are shorter and proportionately wider than those of *M. olivella*, and more work is necessary to determine the status of both forms. Type in TM (E652/7993).

Marginella punicea Laseron, 1948
Rec. Aust. Mus. **22**(1): 38, pl. 5, fig. 7.
= *Kogomea agapeta* (Watson, 1886) **new synonymy.**
Syntype: D14237, adult specimen, dredged alive in 11-16 m (6-9 fm), Sow and Pigs Reef, Port Jackson, N.S.W., collected by C. F. Laseron, date of collection unknown.
Note: This specimen was obtained from Laseron, and is believed to be part of the type series. The types of this species conform exactly to the description of *Kogomea agapeta* (Watson, 1886) and have been compared with a photograph of the holotype (BMNH 1887.2.9.911). The type localities for *M. punicea* are very close to that of *K. agapeta* and it is therefore considered to be a synonym. Other syntypes in AM (C103367).

Marginella ringens May, 1920
Pap. Proc. R. Soc. Tas. **for 1919**: 58, pl. 14, fig. 6.
= *Cystiscus angasi* (Crosse, 1870) **new synonymy.**
Paratypes: D15807, 8 adult specimens (1 damaged, 1 with dried animal), Kelso Bay, Tamar Heads, Tas.,

collected by W. L. May, date of collection unknown.
Note: The shell morphology of this species is within the range of variability of *Cystiscus angasi*, which exhibits an extraordinarily large degree of variation in shell shape (Laseron 1957). We consider it a synonym of that species in the absence of any distinctive features. Holotype in TM (E671/8012).

Marginella (Volvarina) roberti Bavay, 1917
J. Conch. Paris **63**: 104, pl. 2, fig. 8.
= *Volvarina roberti* (Bavay, 1917).
Syntype: D17541, adult specimen, from Madeira, collector and date of collection unknown.
Note: From the May Collection, not the figured syntype. One syntype is reputed to be in the Desjardins Collection, Paris, but the collection cannot be presently located. Other syntypes are held in the Coen Collection, in the Hebrew University, Jerusalem, but they do not include the figured specimen (S. Gofas, pers. comm.).

Marginella schoutanica May, 1913
Pap. Proc. R. Soc. Tas. **for 1912**: 45, pl. 2, fig. 2.
= *Mesoginella schoutanica* (May, 1913).
Paratypes: D15811, 19 adult specimens (3 damaged, 1 with dried animal), dredged in 73 m (40 fm), 3 miles east of Schouten Island, Tas., collected by W. L. May, 27.iii.1910. D16081, 3 adult specimens, with same collection data as D15811.
Note: Holotype in TM (E672/8013).

Marginella shorehami Pritchard & Gatliff, 1899
Proc. R. Soc. Vic. **11**(2): 179, pl. 20, fig. 2.
= *Cystiscus angasi* (Crosse, 1870).
Syntypes: D16098, 3 adult specimens, Shoreham Beach, Westernport Bay, Vic., collector and date of collection unknown.
Note: This species was synonymised with *Cystiscus angasi* (Crosse, 1870) by Laseron (1957). Another syntype in NMV (F548).

Marginella sica Cotton, 1949
Rec. S. Aust. Mus. **9**(2): 200, pl. 19.
= *Austroginella vercoi* (May, 1911) **new synonymy.**
Holotype: D14230, adult specimen, dredged dead in 366 m (200 fm), off Eucla, W.A., collected by J. C. Verco, March 1912. (Figs 3C-D).
Note: As can be seen from the figures, the shell closely resembles that of *A. vercoi* (May, 1911) (Figs 3G-H). The minor differences from that species, in size, the form of the sutures, and lip dentition (Cotton 1949) are all features that exhibit variability in *A. vercoi* populations and are insufficient to justify separation on the basis of a single specimen. The dimensions of the type are similar to those of the holotype of *A. vercoi* (TM E681/8022). Type unique.

Marginella sinapi Laseron, 1948
Rec. Aust. Mus. **22**(1): 40, pl. 5, fig. 15.
= *Mesoginella sinapi* (Laseron, 1948).
Syntypes: D14232, 4 adult specimens (1 damaged), in shell sand, Manly Ocean Beach, N.S.W., collector and date of collection unknown.
Note: These specimens were obtained from Laseron, and are believed to be from the type series. Other syntypes in AM (C103360).

Marginella stilla Hedley, 1903
Mem. Aust. Mus. **4**: 367, text fig. 90.
= *Mesoginella stilla* (Hedley, 1903).
Paratypes: D19099, 2 adult specimens, trawled in mud and pebbles, 137–115 m, 8–12.7 km off Port Kembla, N.S.W., 34°28′S, 151°06–03′E, H.M.C.S. 'Thetis' Stn 49, collected by E. R. Waite, 18.iii.1898.
Note: Laseron (1957) placed this species in the genus *Kogomea* Habe, 1951. However, some important shell features, including the form of the columellar plications and labial dentition, do not correspond with those of that genus. Holotype (C16356) and other paratypes (C163382, C163383) in AM.

Marginella subauriculata May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 86, pl. 2, fig. 7.
= *Cystiscus subauriculatus* (May, 1916).
Paratypes: D16090, 1 damaged adult specimen, dredged dead in 73 m (40 fm), Thouin Bay, Tas., collected by W. L. May, date of collection unknown. D16091, 4 adult specimens (1 damaged, 1 with dried animal), with same collection data as D16090.
Note: The species is very closely related to *Cystiscus angasi* (Crosse, 1870) and may be a form of that species. Holotype in TM (E674/8015), badly broken.

Marginella subbulbosa Tate, 1878
Trans. Proc. Rep. Phil. Soc. Adel. **1**: 86.
= *Kogomea subbulbosa* (Tate, 1878).
Syntypes: D13520, 4 adult specimens (1 damaged), in beach sand, Wauraltie (Port Victoria), Yorke Peninsula, S.A., collected by R. Tate, date of collection unknown. (Figs 3E-F).
Note: The type description only mentions two specimens, and as all the specimens in D13520 are of approximately equal size and form, it is impossible to isolate the actual syntypes. Therefore the status of the whole lot is questionable.

Marginella thouinensis May, 1916
Pap. Proc. R. Soc. Tas. **for 1915**: 86, pl. 2, fig. 8.
= *Cystiscus thouinensis* (May, 1916)
Paratypes: D16089, 2 adult specimens, dredged dead in 73 m (40 fm), Thouin Bay, Tas., collected by W. L. May, date of collection unknown. D16189, 26 adult specimens, with same collection data as D16089.
Note: Holotype in TM (E676/8017).

Marginella tomliniana May, 1918
Pap. Proc. R. Soc. Tas. **for 1917**: 104.
= *Cystiscus tomlinianus* (May, 1918).
Paratypes: D15811, 23 adult specimens (3 damaged), dredged in 73 m (40 fm), off Thouin Bay, Tas., collected by W. L. May, date of collection unknown. D16084, 2 adult specimens, with same collection data as D15811.
Note: New name for *Marginella auriculata* May, 1916 (*non* Menard de la Groye, 1811), and therefore based on the same type series. Holotype in TM (E677/8018), badly broken.

Marginella vercoi May, 1911
Pap. Proc. R. Soc. Tas. **for 1910**: 385, pl. 13, fig. 7.
= *Austroginella vercoi* (May, 1911).
Paratypes: D15816, 9 adult specimens, dredged in 183 m (100 fm), 7 miles east of Cape Pillar, Tas., collected by W. L. May, 18.xii.1907. D16079, 2 adult specimens, with same collection data as D15816. (Figs 3G-H).
Note: Holotype in TM (E681/8022).

Marginella vincentiana Cotton, 1944.
S. Aust. Nat. **22**: 15, fig. 30.
= *Volvarina (Haloginella) vincentiana* (Cotton, 1944).
Lectotype: D13519, adult specimen, in shell sand, Marino, near Adelaide, S.A., collected by R. Tate, date of collection unknown. (Lectotype selected here.) (Figs 1A-B).
Paralectotypes: D18633, 7 specimens (2 immature), with same collection data as lectotype.
Note: New name for *Marginella albida* Tate, 1878, (*non* Lamarck, 1822), and therefore based on the same type series. See note for *M. albida* for further information on types.

Marginella weedingi Cotton, 1944
S. Aust. Nat. **22**: 16, fig. 31.
= *Protoginella geminata* (Hedley, 1912) **new synonymy.**
Holotype: D14989, adult specimen with dried animal, dredged in 36 m (20 fm), Backstairs Passage, S.A., collected by J. C. Verco, date of collection unknown. (Figs 3I-J).
Paratypes: D18637, 14 specimens (11 damaged, 1 immature), dredged dead in 164 m (90 fm), off Cape Jaffa, S.A., collected by J. C. Verco, date of collection unknown. D18638, 25 adult specimens, dredged dead in 100 m (55 fm), off Cape Borda, Kangaroo Island, S.A., collected by J. C. Verco, date of collection unknown. D18639, 2 adult specimens (1 damaged), dredged dead in 110 m (60 fm), other collection data same as D18638. D18640, 42 specimens (13 damaged, 1 immature), dredged dead in 73 m (40 fm), off Beachport, S.A., collected by J. C. Verco, date of collection unknown. D18641, 1 adult specimen, dredged dead in 183 m (100 fm), other collection data same as D18640. D18642, 19 adult specimens (8 damaged), dredged dead in 201 m (110 fm), other collection data same as D18640. D18643, 13 specimens (1 damaged, 1 immature), dredged dead in 274 m (150 fm), other collection data same as D18640. D18644, 6 adult specimens (3 damaged), dredged dead in 366 m (200 fm), other collection data same as D18640.
Note: Cotton (1944) originally described the species as being larger and narrower than *P. geminata*, as well as having differently shaped columellar plications. However, the characteristics of this species are well within the normal range observed for *P. geminata* and examination of the types and other specimens from Gulf St Vincent, S.A., (SAM D6851) supports the conclusion that *M. weedingi* is a junior synonym of *P. geminata*.

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REVISIONARY NOTES ON THE GENUS *DELMA* (SQUAMATA: PYGOPODIDAE) IN SOUTH AUSTRALIA AND THE NORTHERN TERRITORY.

G. M. SHEA

SHEA, G. M. 1991. Revisionary notes on the genus *Delma* (Squamata: Pygopodidae) in South Australia and the Northern Territory. *Rec. S. Aust. Mus.* 25(1): 71-90.

Nine species of *Delma* are recorded from South Australia and the Northern Territory: *D. australis, D. borea, D. butleri, D. fraseri, D. impar, D. inornata, D. molleri, D. nasuta* and *D. tincta. D. australis* is formally recorded from New South Wales for the first time. *D. haroldi* is synonymised with *D. butleri*. A neotype is designated for *D. fraseri*, and an eastern race, *D. f. petersoni* described, having a greater number of scale rows at midbody and a bolder throat pattern. *D. borea, D. pax* and *D. tincta* are placed in a *D. tincta* species group, while *D. impar, D. plebeia* and *D. torquata* are placed in a *D. impar* species group.

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The genus *Delma* is the most speciose genus in the family Pygopodidae. In the most recent revision, Kluge (1974) recognised 13 species, of a total of 30 species in the family. Since that time, museum herpetological collections in Australia have tripled in size, while extensive collections have been made in remote and formerly poorly-studied areas. Within the last four years, the genus has been the subject of attention in the eastern and western thirds of Australia. In eastern Australia, Shea (1987a, b) described two new species *D. labialis* and *D. mitella* from Queensland, recorded the presence of *D. nasuta* in New South Wales, and provided updated spot distribution maps for most taxa occurring in the region. In Western Australia, Storr (1987) and Storr *et al.* (1990) divided *D. nasuta* into two species (one new), described a second new species *D. haroldi*, briefly redescribed the remaining taxa, and provided distribution maps for the state.

This paper links these studies by revising the genus in the intervening area (South Australia and the Northern Territory) for the first time since Kluge's (1974) revision, and discusses the identity of *D. fraseri*, type species of the genus.

Although the monophyly of the genus is an unresolved issue (Shea 1987a), there is little doubt that the species placed in *Delma* by recent workers are at least a close-knit grade, readily differentiated from both more derived and relatively primitive members of the family (Kluge 1976), and for this paper I accept the phenetic diagnosis of the genus provided by Kluge (1974).

Materials and Methods

This study is based on the examination of material in the Australian Museum (AM), British Museum (Natural History) (BMNH), Museum of Victoria (MV), Northern Territory Museum (NTM), Queensland Museum (QM), South Australian Museum (SAM), Western Australian Museum (WAM) and Central Australian Wildlife Collection (CAWC), the latter collection now lodged in the Northern Territory Museum.

Scalation nomenclature follows Shea (1987a) with one exception. The second supralabial scale caudal to the elongate subocular supralabial has previously been generally considered to be the caudalmost (Kluge 1974; Shea 1987a; Storr 1987). However, in specimens preserved with open mouth, the third supralabial scale caudal to the subocular supralabial is at the caudalmost extent of the circumoral scalation. Hence, the supralabial and infralabial scale counts used here are one greater than counts in previous works.

I have used only derived characters to hypothesise relationships between taxa, and have used *Pygopus lepidopodus* and *P. nigriceps*, the two most generally primitive species in the family (Kluge 1974, 1976) as outgroups to determine polarity of characters.

Systematics

Delma australis Kluge, 1974: 77.

Diagnosis

A small species of *Delma* (maximum SVL 88 mm), with ventral body scales not markedly dilated relative to more lateral scales, a single pair of supranasal scales, modally 18 midbody scales and fourth supralabial in subocular position, loreal scale row usually interrupted by a ventral extension of

prefrontal scale contacting supralabials, and body venter grey (often tinged with pink in life).

Description

See Kluge (1974) and Storr *et al.* (1990).

Distribution

In South Australia, occurs in the south-west, from the Western Australian border east to the Flinders Ranges, and including the southern fringe of the Great Victoria Desert, Gawler Ranges and Eyre Peninsula. Apparent isolates in the western part of the Lake Eyre drainage, the Tomkinson and Musgrave Ranges, Danggali Conservation Park, and to the south of the Murray River, between Tailem Bend and Scorpion Well Conservation Park (Fig. 1).

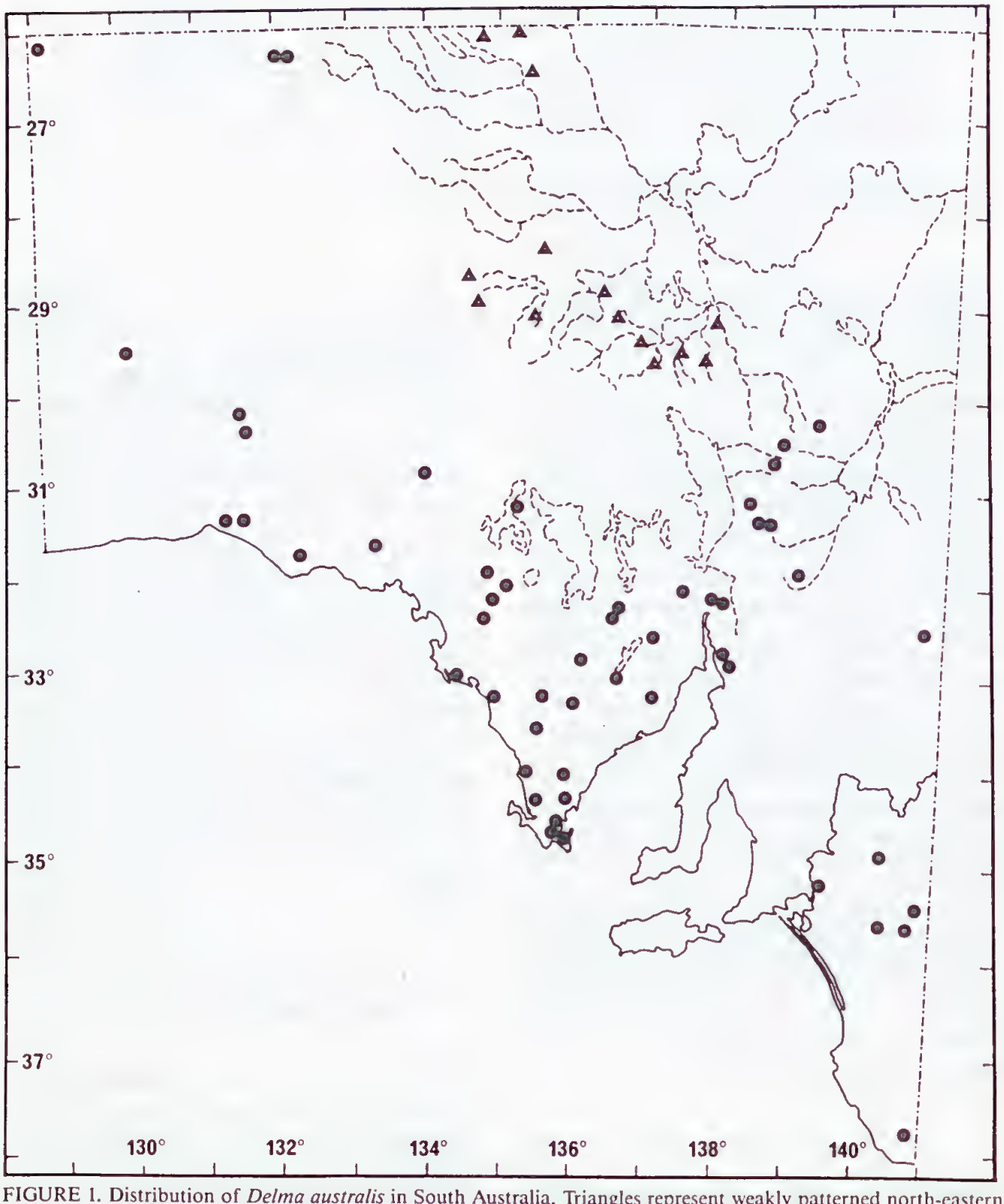

FIGURE 1. Distribution of *Delma australis* in South Australia. Triangles represent weakly patterned north-eastern population.

Also occurs in southern W.A., south-west N.S.W. and north-west Victoria (Kluge 1974; Storr *et al.* 1990; this paper).

Remarks

There is noticeable geographic variation in the intensity of the head pattern in this species in South Australia. Most specimens from the southern half of the state and the Tomkinson and Musgrave Ranges in the north-west have strong dark variegations on the head, although the pattern is reduced, particularly laterally, in a few specimens. Material from the western part of the Lake Eyre drainage (east of 134°E, north of 30°S) consistently either lack dark markings on the head or have such markings very reduced.

The single old record from the Northern Territory (SAM R2240; Alice Springs, no collector or date recorded) was considered to be suspect by Kluge (1974). Extensive collections of reptiles from the Alice Springs area since the early 1970s have included numerous *Delma tincta,* and several *D. borea, D. butleri* and *D. nasuta,* but no additional material of *D. australis.* Consequently, I consider the locality for SAM R2240 erroneous.

Delma australis has not previously been formally recorded from New South Wales, although Cogger (1975) maps the species in the south-west corner of the state. Five specimens (AM R39495, R55010, R93142, R118635, R118637) confirm the presence of the species in New South Wales.

Habitat

The majority of specimens of the southern and western populations in South Australia are from *Triodia* or mallee habitats, or combinations of both (45 specimens from 24 localities), generally taken from in or under *Triodia* clumps or mallee leaf litter. The former habitat is shared with *D. butleri.* My impression, having collected both species in W.A., S.A. and N.S.W., including the Coombah area where the two taxa are sympatric, is that *D. australis* occurs in slightly moister situations than *D. butleri.* There is some support for this view from the association of several records with watercourses (SAM R14351 'under dead log near water pond', R16205 'in burrow under *Triodia*, creek flank', R21015 'on bank of watercourse lined with Coolibah *(Eucalyptus microtheca)*', R22193 'under rock near water', R25071–72 'in storm drain along creek').

One specimen, SAM R15009, was 'pit-trapped overnight', suggesting nocturnal activity.

There are almost no habitat data associated with specimens of the north-eastern unpatterned form. SAM R30401 was taken in a pitfall on a gibber plain with *Atriplex.*

Specimens examined

New South Wales: AM R39495, 'Glenea', 70 mi. N Roto; R55010, 12 km S Matakana; R93142, Round Hill Fauna Reserve; R118635, 14.2 km N Coombah Roadhouse on Silver City Hwy; R118637, 13.5 km N Coombah Roadhouse on Silver City Hwy.

South Australia (patterned form): AM R17306–08, Mt Davies, Tomkinson Ranges; R17460, Musgrave Ranges; R62391, nr Sleaford, Port Lincoln; R79914–15, 2–3 km SE Mt Hope; R79916, N side Pillie Lake; R79917, R79919, R79943, SE side Port Lincoln; R79920–21, 8.4 km W Ungarra P.O. by Yeelanina rd; R107950, 15.6 km E Nundroo via Eyre Hwy; NTM R9252, SAM R17752a-b, Marble Range; SAM R380, Mitchell; R3123, Ernabella Mission; R3852, R10374, 15 mi. N Poochera; R3872, 'Kokatha'; R4301, Port Germein Gorge; R5375, R10376, Gawler Ranges; R5613, 5 mi. W Arkaroola; R9189, R9213, Blesing Reserve; R9224, 4 mi. S Baird Bay; R10375, nr 'Kokatha'; R10800, Watson; R12454–55, 'Corunna'; R12481, R12669, Miccollo Hill, 'Siam'; R12670, 3 mi. NW Tailem Bend; R12746–47, Mambray Creek National Park; R12751, R14695, Corunna Hills; R13227, 7 mi. WNW Kenmore Park; R13908, Lake Gilles Conservation Park; R14086, Whaler's Way, Port Lincoln; R14093, Scorpion Well Conservation Park; R14190, R16678, Billiat Conservation Park; R14351, 3 mi. past Moonabie Pass, 30 mi. S Whyalla; R14914, 'Baratta'; R14963, R24514, Mt Finke; R15009, 23 km N Koonibba Mission; R15195a-b, R15619, S of Scorpion Springs Conservation Park; R15954, Parachilna; R15958, Mt Serle; R16060, R17106, Danggali Conservation Park; R16176, abandoned piggery, W Bordertown-Pinaroo rd; R16205, Mt Hack, 38 km E Beltana; R16212, Depot Creek Gorge; R16227, Ninety Mile Desert; R16521, Gum Creek, Corunna Hills; R16522a-b, nr Millalee Creek, N Port Lincoln; R16650, 'Bibliando'; R16765, R16844, R17845, R17860a-c, R23233, R24184–86, Uro Bluff; R17144, Pinkawillinie Reserve; R19898–99, 'Koondoolka'; R22784, R23091–93, Mt Remarkable National Park, 2.1 km E Sugargum Lookout; R24298, 0.7 km SSW Old Siam H.S.; R24445, E end Brachina Gorge; R24865, nr 'Oraparinna' H.S.; R25071–73, Stoney Creek; R25349, Hambidge Conservation Park; R26333, 22 km NW Yalata Roadhouse; R26339, 20 km W Yalata Roadhouse; R26349, 50 km W Yalata Roadhouse; R28540, 77.5 km N Minnipa; R32127, 11 km SSW Maralinga; R32168, 8.5 km SW Maralinga; R32278, 50 km SW Hanilar Lake; R32498, Bascombe Well Conservation Park; R32894, Wanna; R32912, 3 km along Talia Caves rd from turnoff on Flinders Hwy; WAM R24528, 37 km ENE Wirrulla.

South Australia (unpatterned north-eastern form): AM R17622, Coober Pedy; SAM R12756a-b, 'Muloorina'; R14342, Margaret River, S of Lake Eyre; R17048, Coward Springs; R21015, Balta Baltana Hill; R22193, Hermit Hill; R25826, William Creek; R25857–58, Mt Dare; R28130, 'Stuart Creek'; R28138, W of Mareè; R28172, Beresford Rail Siding; R28215, 'Dalhousie' ruins; R28248–51, R28258–60, Abminga Rail Station; R29000, SW of Warrina; R30401, Breakaways Reserve, 25 km NNW Coober Pedy.

Victoria: AM R42724, Lowan Sanctuary, 20 mi. W Piangil; R54889, 15 mi. W. Annuello; R84294, R84297–98, Hattah.

Western Australia: AM R8778, Mt Barker; R11114, Woodlands, Tambellup; R101995, R102004, Hamelin Pool,

'Hamelin'; R102005, *ca* 21.4 km N 'Nerren Nerren' turnoff via North-West Coastal Hwy; R105720, 34.7 km N Tamala turnoff on Denham rd; R105740, 3.2 km S Nanga turnoff on Denham rd; R105813–15, 45.1 km W Newman Rocks turnoff on Eyre Hwy; R105879, 39.8 km E Cocklebiddy Roadhouse on Eyre Hwy; R117736, west side Boulder; BMNH 1904.10.7.18, Coolgardie district.

Delma borea Kluge, 1974: 81.

Diagnosis

A small to moderate-sized species of *Delma* (maximum SVL 98 mm; Storr *et al.* 1990) with two pairs of supranasals, fourth supralabial usually subocular, modally 16 midbody scales and, in juveniles and subadults at least, a dark head dorsally and laterally, with narrow pale bands (one preocular, one postocular, one auricular, usually forked laterally, one branch running along each edge of ear, and one nuchal), but mid-throat region immaculate, pale.

Description

See Kluge (1974) and Storr *et al.* (1990).

Distribution

In the Northern Territory, most common in the Top End, north of 'Wave Hill', 'Helen Springs' and 50 km S MacArthur River camp, and including Groote Eylandt, Bathurst I., Cape Wessel I., Melville I. and Vanderlin I. (Fig. 2). The few records from further south (Alice Springs, Arltunga ruins, Ayers Rock, Barrow Creek, George Gill Range, Heavitree Gap, Kintore Range, Mt Doreen) are generally from rocky areas.

Also occurs in Western Australia (Kimberley and its southern fringe, eastern Pilbara, Barrow I., Hermite I., Rosemary I. and Warburton Range) and western Queensland (Storr *et al.* 1990; Shea 1987a).

Habitat

Kluge (1974) stated that *D. borea* was most frequently encountered in regions of stony, hard soil and *Triodia*, but that it did not appear to occupy *Triodia* on sandplains. However, most specimens collected from the Northern Territory are from savanna woodland lacking *Triodia*. Around Darwin, in particular, the species seems to be abundant, sheltering under debris and leaf litter. The 40 specimens from the Top End for which microhabitat data are available were found in or under leaf litter, grass, exfoliated bark, logs and rubbish (tin, cement slabs, compost and boards). However, the two Heavitree Gap specimens from further south were found under rocks beneath *Triodia* tussocks on a steep hillslope.

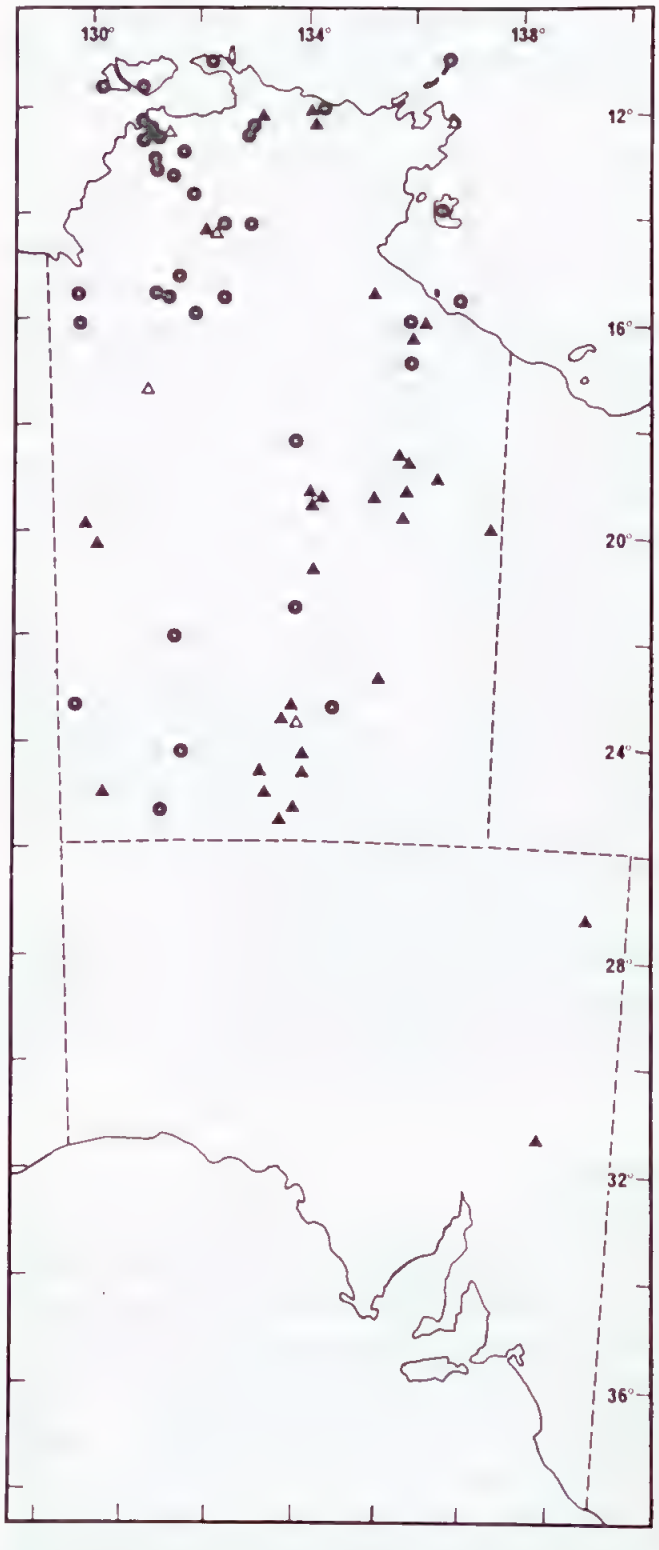

FIGURE 2. Distribution of *Delma borea* (dots) and *D. tincta* (closed triangles) in the Northern Territory and South Australia. Open triangles represent localities of sympatry or near sympatry.

Remarks

Delma borea, *D. tincta* and *D. pax* have very similar colour patterns, and largely replace each other geographically. They appear to comprise a species group, the *D. tincta* group, diagnosable by the usual presence of only a single elongate upper

temporal scale bordering the parietals, a character otherwise common in *Delma* only in *D. plebeia* (frequency: *D. borea*, 93.8%, n = 65; *D. pax*, 96.5%, n = 57; *D. tincta*, 97.4%, n = 115; *D. plebeia*, 76.9%, n = 13). Within the *D. tincta* group, three scalation characters separate the species. *D. borea* typically has two pairs of supranasals, fourth supralabial below eye, and 16 midbody scales; *D. tincta* typically has one pair of supranasals, third supralabial below eye, and 14 midbody scales, while *D. pax* is intermediate in having two pairs of supranasals, third supralabial below eye, and 16 midbody scales. However, occasional specimens show different combinations of these three characters, and proved difficult to assign to species. The problem seemed most acute in the case of *D. borea/D. pax*, which differed only in the number of the subocular supralabial, and as initially described were widely separated geographically (Kluge 1974), but had both recently been recorded from the Pilbara (Storr *et al.* 1990). Examination of all material of *D. pax* in the WAM collection revealed that the two taxa may additionally be differentiated by several subtle coloration differences. In *D. pax*, the pale postocular band broadens ventrally (even width or only slightly broader ventrally in *D. borea)*, the auricular band is often broader laterally, and there is no ventrolateral series of parallel pale streaks along neck and forebody (usually present in *D. borea)*. On the basis of these additional characters, *D. pax* appears to replace *D. borea* in the western Pilbara and along the north-west coast north to 'Anna Plains', while *D. borea* is largely confined to the Kimberley, south to East Palm Spring in the Denison Range, with populations on several islands (Barrow, Rosemary, Hermite) off the Pilbara coast, and one record (WAM R25201, 32 km E Jiggalong) from the eastern Pilbara.

The identity of the single Ayers Rock specimen (CAWC R1319) is problematic. The colour pattern is similar to typical *D. borea*, but although the specimen is of adult size (SVL 86.5 mm), the head is black with narrow white bands. Such intensity of pattern is rare in adult *D. borea* and *D. tincta*, and has not been seen in *D. pax*. The specimen has two pairs of supranasal scales and 16 midbody scales, typical of *D. borea*, but the third supralabial is subocular, typical of *D. tincta* and *D. pax*. Until further material becomes available, I refer this specimen to *D. borea*, on the basis of the number of supranasal and midbody scales.

Specimens examined

Northern Territory: AM R3662, R4162, R62673, QM J1781, Port Darwin; AM R8249, R12877, R14161, R19121, R38021, R127980, R128741, CAWC R9, R1680, R4582, R3080, NTM R9930-31, WAM R21980, R40296, R40835, Darwin; AM R12794, R12841, R13004, Darwin area; R12901, Westhead, Darwin; R13471, R13609, CAWC R4950, NTM R7456, Groote Eylandt; AM R13569-70, R13648, R62670-72, Cape Arnhem; R13713, R13777, WAM R23480, Nightcliff, Darwin; AM R14336, NT; R30014-15, R107502, Black Point, Port Essington; R52135-36, Heavitree Gap, Alice Springs; R52137, Adelaide River township; R53149, Mt Doreen; R54745, *ca* 50 km S McArthur River camp; R54746, 30 km N McArthur River camp; R55904, Vanderlin I.; R61573, Maningrida; R73069, R76043, Bullo River Stn rd, 31 km NW Victoria Hwy; R75511, midreaches McKinlay River; R80369, 25 km S Larrimah on Stuart Hwy; R88876, Jabiluka project area; R98442, vicinity of 009 Gauge Stn, Magela Creek drainage; R112829, Mindil Beach Casino site; BMNH 1932.3.7.25, 'central Australia'; 1973.3285, Kintore Range (23°21'S 129°23'E) (formerly JSE 269); CAWC R1318, R1320, Arltunga ruins; R1319, Ayers Rock; R5511, Beatrice Hill; MV D174, Alice Springs; NTM R159, Riverview Caravan Park; R173-174, Pine Creek; R1040, Maclear Creek, S side Melville I.; R1317, R5371, Barrow Creek; R1779, SAM R8409, Katherine; NTM R1947-51, Millner School grounds; R2045, Mt Carr; R2082, Winellie; R2108-09, R3051, Rapid Creek; R2429, R2507-08, R3053, Millner; R2954, R3052, R8705, Stuart Park; R3144, R3146, R3194-97, R3218-21, R7593-98, Ban Ban Spring; R3299, Berry Springs; R3411, Allawa; R3791, Katherine district; R3870, Jabiru tip; R5825, R6516-17, R6609-10, Wave Hill; R6594, 70 km N Top Springs; R7744, Cape Wessel I.; R7883, R7946, Cape Fourcroy, Bathurst I.; R8120, the 17 mile, S of Darwin; R8306, 2 km W Victoria River bridge on Victoria Hwy; R8340, Ludmilla; R9133, Keep River National Park; R9457, 20 km N Mataranka; R9467, 110 km W Katherine; R9494, Bees Creek, nr Darwin; R9496, Fannie Bay; R11696, R12956, Katherine Gorge National Park; R12727, George Gill Range; R13221, Humpty Doo; R13237, Gregory National Park; QM J39334, Cahills Crossing, East Alligator River; WAM R13496, R34331-32, Yirrkala; R24198, Helen Springs; R24001, 11 km N Adelaide River; R26224, Parap.

Queensland: AM R26138-39, R28445, R107000, Mt Isa; R31627, R31629-30, Mt Isa district; R60248, 3 km W Cloncurry on Flinders Hwy; R63589, Bang Bang jumpup on Hwy 83; R90212, Inca Creek; R110534, Scotts Tank, 'Diamantina Lakes'; R110601, 6 km E Scotts Tank, 'Diamantina Lakes'.

Western Australia: AM R14160, Forrest River Mission; R40518-19, junction Ord and Behn Rivers; R49970, Balgo Mission; R56822, Halls Creek; R117604, vicinity of Cape Lefeque; R126188, Mitchell Plateau airstrip; BMNH 1966.415, Wooroloo [in error]; NTM R7286-87, 167 km E Fitzroy Crossing; R13047, 3 mi. S main Ord River Dam site; SAM R5058, Warburton Range; WAM R11240, Wotjulum; R25201, 32 km E Jiggalong; R28656, Barrow I.; R37371, Rosemary I.; R37406, Hermite I.; R37703, Hidden Valley; R43075, Crystal Creek near Crystal Head; R44566, mouth of Behn River, Lake Argyle; R44575, 2-3 mi. upstream Ord River from Behn River junction; R48559, nr Shark Point, Barrow Island; R60352, 3 km E Nicholson; R70564, 5.2 km 202° Mt Percy; R75533, 11 km WNW New Lissadell H.S.; R94881, Lake Argyle; R96944, north-west hump of the Dromedaries; R99776, 10 km SW Silent Grove.

No data: AM R55613-14, BMNH 1946.8.26.99, NTM R3558, R5811.

Delma butleri Storr, 1987: 346.

Diagnosis

A moderate-sized relatively inornate species of *Delma* (maximum SVL 96 mm) with two pairs of supranasal scales, the caudal pair contacting or only narrowly separated from the nostril, modally 16 midbody scales and fourth supralabial subocular, usually four loreals, snout short (Fig. 3), and venter without dark markings.

Description

See Storr (1987) (as both *D. butleri* and *D. haroldi*) and Shea (1987b) (as *D. nasuta*).

Distribution

Extreme south of Northern Territory (Alice Springs and vicinity of Uluru National Park) and the adjacent far north-west corner of South Australia, and arid southern South Australia, south of 43 km NE Maralinga, Mt Finke, 118 km NE Minnipa, Uro Bluff, Parachilna, Paralana Hot Springs and Danggali Conservation Park, with a possible north-eastern isolate near the South Australian/Queensland border (Figure 4). Also occurs in the arid parts of W.A. (Storr 1987, as *D. butleri* and *D. haroldi*) and south-western N.S.W. and north-western Victoria (Shea 1987b, as *D. nasuta*). An early record from St Francis I. (BMNH 1922.11.8.8–10) has not been confirmed by recent collections from that island and must be treated as suspect.

Remarks

Storr (1987) separated this species from *D. nasuta*, but referred to it only material from Western Australia and western South Australia. This distribution was followed by Wilson & Knowles

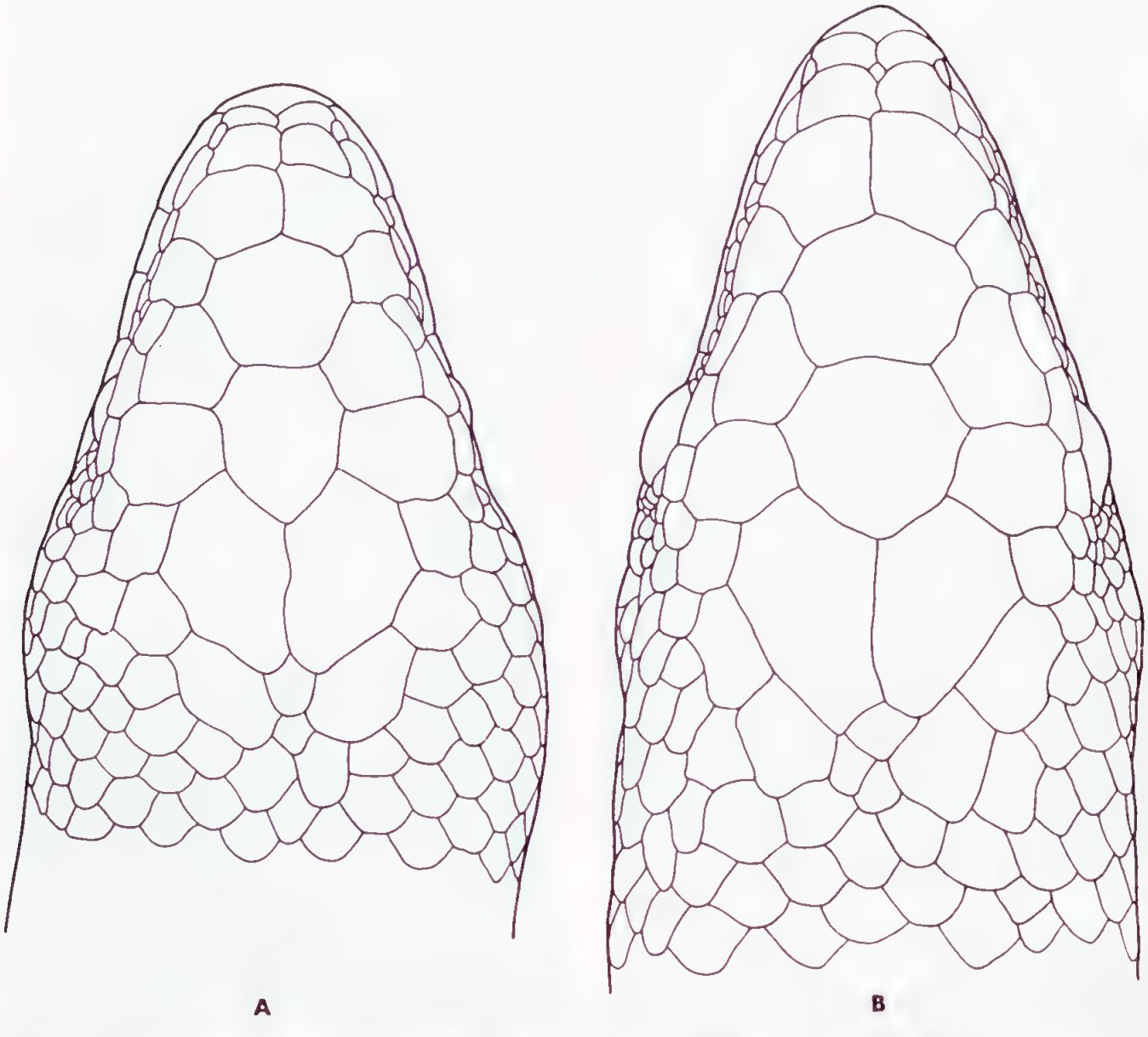

FIGURE 3. Dorsal view of heads of A. *Delma butleri* (AM R44362) and B. *D. nasuta* (AM R17376).

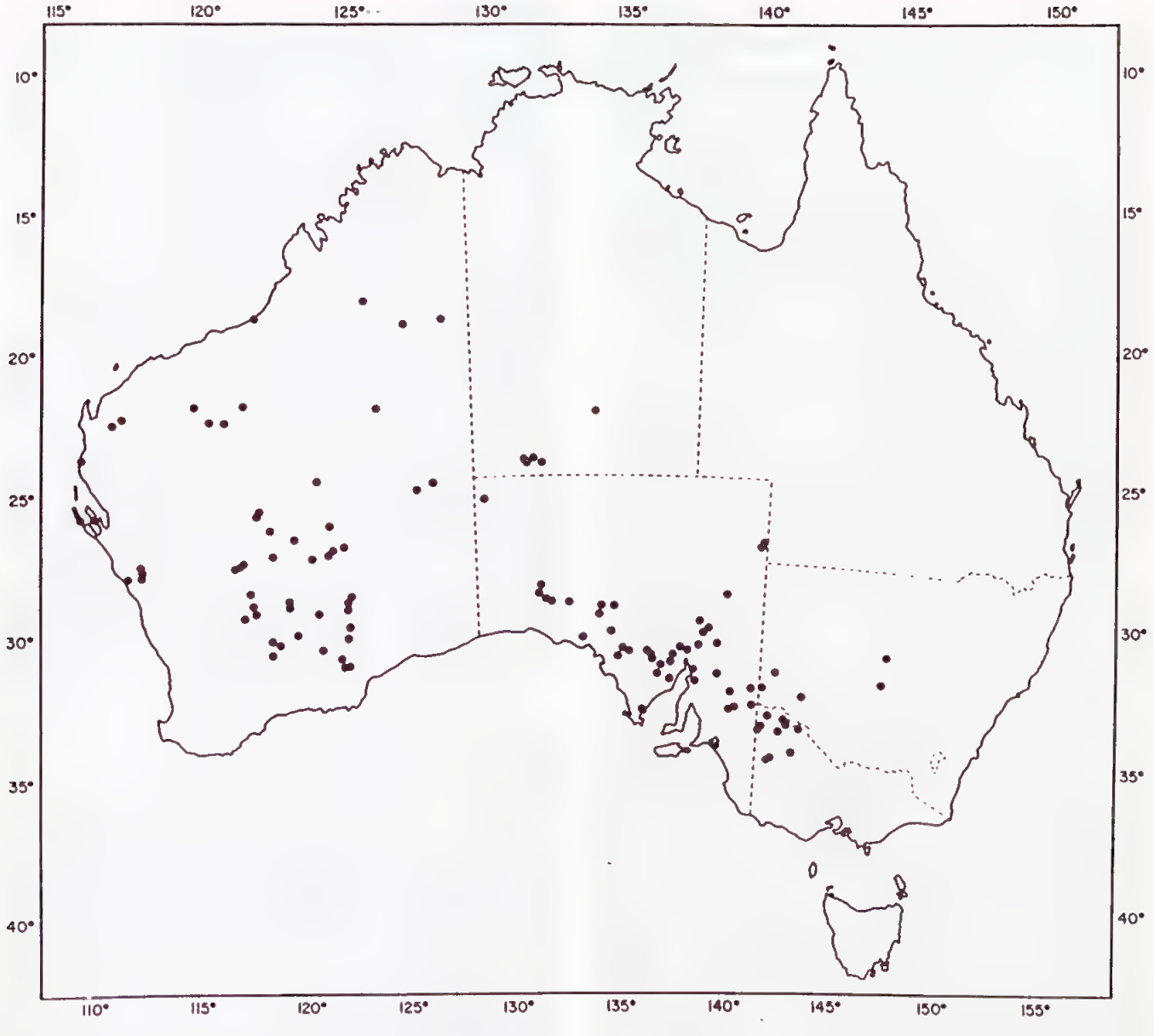

FIGURE 4. Distribution of *Delma butleri.*

(1988). However, comparison with the type series of *D. butleri* indicates that all southern populations referred to *D. nasuta* by Kluge (1974) and Shea (1987a) are *D. butleri.* To the recorded instances of sympatry between *D. butleri* and *D. nasuta* can be added SAM R12674 (*D. butleri*) and R12675 (*D. nasuta*) both from Warburton Range.

In describing *D. haroldi,* Storr (1987) only compared it with *D. borea,* to which species the type series had previously been identified. However, *D. haroldi* consistently has two or more upper temporal scales and cannot be placed in the *D. tincta* species group with *D. borea.* When the descriptions of *D. haroldi* and *D. butleri* are compared, it becomes evident that there are very few, if any, differences between these two taxa. The populations of *D. butleri* geographically closest to *D. haroldi,* in the Pilbara, are also the most similar in coloration, with well developed pale bars laterally on the face and neck. Significantly, these populations have two additional pale bars between the pale postocular and auricular bars, a character otherwise seen only in *D. haroldi.* Specimens identified as *D. butleri* (WAM R94585) and *D. haroldi* (WAM R64715; fig. 3 in Storr 1987) both from the vicinity of Marandoo, W.A. are almost identical, and clearly conspecific, as is another specimen (WAM R53760) from the same locality, and the specimen of *D. haroldi* (WAM R63632) from 19.5 km SE of Mt Meharry. Of the remaining types of *D. haroldi,* the seven specimens from the Kimberley, adjacent parts of the Eastern Division, and the Pilbara coastal lowlands (WAM R46043, R64703, R63427, R45243, R45811, R51722, R85094) have only a single pale

temporal band between postocular and auricular bands. However, the paratype (WAM R73630) from Ophthalmia Range, geographically intermediate between the Marandoo and Eastern Division material, has an intermediate condition, with one pale temporal band on one side forking into two bars on the other. Seven specimens from central Australia (AM R14362, R96116, CAWC R1321, R1323, R1636; SAM R29900, R29935) are variable in this character, some having one band, others showing division of this band ventrally. Because of this wide zone of apparent intermediates, apparently an extension of the south-east to north-west gradation in the development and intensity of facial markings previously noted within *D. butleri* (Storr 1987), I synonymise *D. haroldi* and *D. butleri*. As both were described in the same publication, I nominate *D. butleri* (which has page priority) to have priority over *D. haroldi*. Whether the typical *'haroldi'* from the extreme north and north-west of the distribution can be recognised at a subspecies level awaits the collection of further material from the intervening areas.

Variation in *D. butleri* throughout the southern part of its range is minimal. Live material I have examined from 23 km ENE of Yuna, W.A. in the west of the distribution was similar to material from 23 km ENE of Kimba, S.A., and the N.S.W. material illustrated by Shea (1987b). Most of this material had only very slight development of pale facial markings, reduced to 1–2 lip bars preocularly and 2 lip bars postocularly.

The five specimens from Dirk Hartog Island differ from mainland populations in being noticeably more bulky and having 17 nuchal scales (*vs* 15–17, usually 15 for other North West Division material), more broken pale markings of reduced contrast, but with dark edges, a dark apical spot on each dorsal body scale, and a lighter brown dorsal ground.

Habitat

Like populations in W.A. (Storr 1987) and N.S.W. and Victoria (Shea 1987b), S.A. and N.T. populations are *Triodia* inhabitants. All 48 specimens for which field data are available were either taken from live or dead *Triodia* clumps or from habitats noted to contain *Triodia*. The substrate, where noted, ranged from sand dunes to rocky hillslopes, and the overstory at various localities included mallee eucalypts, *Casuarina, Melaleuca* and *Heterodendron*.

Specimens examined

New South Wales: see Shea (1987b).

Northern Territory: AM R14362, road, 'Curtin Springs' to Ayers Rock; CAWC R1321, R1323, Ayers Rock; R1636, Uluru National Park, 15 km S on Britten Jones track; R4808, Alice Springs; SAM R29900, R29935, 24 km along 'Mulga Park' road, SSE 'Curtin Springs'.

South Australia: AM R7649, Immarna; R105536–37, 23.0 km ENE Kimba; R115906–08, Pandappa Hill; BMNH 1922.11.8.8–10, St Francis I.; MV D2659, W of Kychering Soak, No. 3, Overland Railway to WA on line of march; D15453–54, Renmark; NTM R9212, SAM R13919, R17716, Immarna; NTM R9295–96, SAM R16283, 'Canopus'; SAM R54, Waikerie; R3066a–b, Birthday Well, 'Cariewerloo'; R3067, 'Coralbignie'; R3851a–d, 15 mi. N Poochera; R3878a–c, Wilson; R5022a–c, West Coast; R5376a–c, Gawler Range; R10727–28, Mamblin; R10932, Paralana Hot Springs; R12450–51, R14687, R14696, Corunna Hills; R13041, 'Hiltaba' H.S.; R14020, Baroota Reserve; R14225, Childara Rockholes; R14463, Mambray Creek National Park; R14568, Lincoln Way, 48 km SW Whyalla; R17338, 21 km E Blanchetown; R19900–01, nr Chinaman Dam, 'Yardea'; R14913, 'Baratta'; R14964, Mt Finke; R14982, 22 km E Barton Rail Station; R15353, Uno Range; R15955, Parachilna; R16211, Depot Creek Gorge, 34 km NNE Port Augusta; R16523, nr Millalee Creek, N Port Lincoln; R16524, Gum Creek, Corunna Hills; R16649, 'Bibliando'; R16755, Wilgena Hill; R16843a–b, R17844a–b, R17871, R23767, R24134, R24158–59, R24163, Uro Bluff; R17120, R17659a–b, Danggali Conservation Park; R17681, 'Balah'; R17984, R18002, Lake Gilles Conservation Park; R18121a–c, S of 'Hypurna'; R18763–64, 1 km NNE Iron Duke; R18768, 1 km W Iron Duke; R17458, Wilpena Motel; R22301, 2 km E Ooldea; R24297, S of 'Kolendo' H.S.; R24863, nr 'Oraparinna' H.S.; R25515–17, R25535, R25731, Danggali Conservation Park nr 'Canopus'; R28495, 118 km NE Minnipa; R28568, 73 km N Minnipa; R29090, Bowman Park Reserve; R31361–62, Iron Duke; R31949, S Inila Rock Waters; R32137, 9.7 km SSW Maralinga; R33795, 12 km SSE Dulingari Oil and Gas Satellite; R33803, Toolachie Gas Satellite; WAM R36649, 43 km NE Maralinga; R44362, 34 mi. NW Mt Lindsay, Birksgate Range.

Victoria: see Shea (1987b).

Western Australia: AM R86501–02, 2.5 km SW Condun Well; R96116, 150 km SW Giles Meteorological Station on road to Warburton; R105791, 36.1 km N Widgiemooltha Roadhouse on Coolgardie Hwy; SAM R12674, Warburton Range; WAM R18551, Queen Victoria Spring; R21073, 33 km W Carnegie; R26503, 35 km NE Yuna; R28359, 16 km N Ethel Creek; R45243, 28 mi. N Windy Corner; R45811, Wallal; R45850, 8 mi. S of H.S., Dirk Hartog I.; R46043, 91 mi. E McLarty Hills: R47709, Northampton; R48184–88, R48261, R48270, East Yuna Nature Reserve, 30 km SE Yuna; R51722, 2 km SW Barradale; R53255–56, Ivor Rocks; R53277, 75 km N Kalgoorlie; R53291, 27 km NE 'White Cliffs' H.S.; R53459–60, Newman Rock; R53760, R94585, Mt Bruce, Marandoo; R54556, 25 km S Denham; R57087–88, R57093, 3 km N Cape Ransonnet, Dirk Hartog I.; R57094, 5 km N Cape Ransonnet, Dirk Hartog I.; R57522, 40 km NE Yuna; R57541, 44 km NE Yuna; R57959, R58072, 4 km E Boingaring Rocks; R59854–55, 17 km N Charlina Rock; R62822, 22 km SE Mt Keith; R63427, Twin Heads; R63632, 19.5 km SE Mt Meharry; R64703, Balgo Mission; R64715, Marandoo; R64754–55, Mt Manning Range; R64794, R64813–14, Blue Hill, Lake Barlee; R65367, R65463, R65484, 30 km NW Heartbreak Ridge; R65531, R65569–70, R65654, R72503, R74557, R74597, 3.5 km SW Buningonia Spring; R65539, R65590, R74591, 1.5 km SE

Buningonia Spring; R67188, 15 km NE Bungalbin Hill; R67974, Ramona Well, 35 km 164° Dandaraga; R69080, R69104, R74658, 8.7 km ENE 'Yuinmery' H.S.; R69108, 8.0 km ENE 'Yuinmery' H.S.; R69288, 12.5 km SSE 'Banjiwarn' H.S.; R70876–77, 2 km N Mt Windarra; R70893, 1 km 45° Yowie Rockhole; R71775, 32.5 km 182° Woolgangie rail siding; R72248, R72255–56, R72285–86, R72291, nr Boorabbin; R72537, 3.0 km SW Buningonia Spring; R72669, 2.5 km NE Comet Vale; R72728, 3.5 km NE Comet Vale; R73212, R73228–29, 6 km 78° Yowie Rockhole; R73630, Ophthalmia Range area; R74677, R74679, 24 km ENE 'Yuinmery'; R74784, 9.5 km SSE Banjiwarn; R75559, East Yuna Nature Reserve; R76121, 16 km SSW Mt Jackson Hill; R76645, 3 km SE 'Gnaraloo' H.S.; R76742, 5 km SE 'Gnaraloo' H.S.; R78548, 30 km SSE Mt Keith; R78553, 29 km SE Mt Keith; R78680, 5 km W Mt Manning Range (S.E. Peak); R78688, 4 km W Mt Manning Range (S.E. Peak); R78689, 12 km W Mt Manning Range (S.E. Peak); R85094, 11 km NNW 'Uaroo' H.S.; R85305, 4 km ESE Big Shot Bore; R85600–01, R85603–04, 39 km E Laverton; R85605–06, 8 km WNW Pt Salvation; R86658, 37 km S Agnew; R90291, 9 km ENE 'Yuinmery' H.S.; R91510, 4 km E Zanthus; R94077, 53 km NNE Queen Victoria Spring; R97262, Queen Victoria Spring National Park; R97303, 23 km ENE Yuna; R99603, R99759, Mt Lawrence Wells; R99654, 9 km NNE Mt Lawrence Wells.

No data: BMNH 1966.5.

Delma fraseri Gray, 1831a: 14.

i. The identity of *Delma fraseri*

Delma fraseri was described by Gray in two works published in the same year (Gray 1831a,b). Kluge (1974) discussed the priority of these two works, and considered Gray (1831a) to be the earlier description. This conclusion was later followed by Cogger *et al.* (1983). Gray (1831a) did not state the number of specimens on which he based his description, although the single set of measurements and lack of any variation suggest that only a single specimen was before him at the time. At least one specimen was in the British Museum collection (Gray 1831b). Ten years later, Gray (1841) provided an illustration of *D. fraseri.* Still later, in his catalogue of the lizards in the British Museum, Gray (1845) lists two specimens, one adult from Western Australia presented by James Hunter (presumably the type) and a half-grown specimen from Western Australia from Gilbert's collection (presumably the naturalist John Gilbert). Boulenger (1885) in the second catalogue of British Museum lizards, lists two halfgrown syntypes, both from 'W. Australia', presented by J. Hunter, but no Gilbert specimen.

In restricting the name *D. fraseri* to a south-western species, Kluge (1974) used three characters from Gray's (1831a) description (two pairs of supranasals [presumably based on Gray's description of 'head . . . covered with four pair and three odd central plates'], three preanals, and banded head and neck) and two characters from Gray's (1841) illustration (dark throat markings, and fourth supralabial in subocular position), but did not examine the purported syntypes.

I have examined both specimens (now BMNH 1946.8.26.98–99). The former specimen is clearly that illustrated by Gray (1841), although the illustration is reversed. This juvenile specimen is conspecific with *Delma fraseri* (*sensu* Kluge). However, it is not the specimen measured by Gray (1831a), having SVL 52 mm and tail length 135 mm (*vs* '2 inches, 8 lines' [= 68 mm] and '3 inches 8 lines' [= 93 mm]). The second specimen, almost broken at midbody, has more similar but slightly greater measurements (SVL 71 mm; tail length 97 mm) to those given by Gray (1831a). This specimen, however, is conspecific with *D. borea* Kluge, 1974. No other *Delma* specimen currently in the British Museum (Natural History) is of suitable age to be a potential type.

The morphological characters provided by Gray (1831a) apply equally to *D. borea* and *D. fraseri* (*sensu* Kluge), as well as to several other *Delma* species. The description of the head and neck markings is ambiguous, and different interpretations could fit either species.

Gray's (1831a) description reads (in part): 'head and lips black, with four narrow cross lines, one between the nostril and the eyes, two just behind the eyes, the third broader over the eyes, and the last edging the occiput'. Presumably the 'four narrow cross lines' are pale bands on the black ground (Gray 1831b). Both *D. borea* and *D. fraseri* (*sensu* Kluge) have a preocular band ('between the nostril and the eyes' and presumably the first of the four cross-lines). If 'two just behind the eyes' is interpreted as a dorsally broken postocular band, the description fits *D. fraseri* (*sensu* Kluge), not *D. borea,* which has a complete postocular band. However, the position of the third band is then difficult to interpret. If 'two just behind the eyes' is interpreted as the successive second and third bands, these must be complete postocular and auricular bands, and the last band must be the pale edging to the dark nape patch, agreeing with *D. borea* and not *D. fraseri* (*sensu* Kluge), although the third band is again problematic, over the ears, not the eyes.

The 'discoverer' of *D. fraseri,* James Hunter, may be the James Hunter who was one of the naturalists on P. P. King's 1818–1822 survey of the Australian coast. This voyage visited both the south-west and north coasts of the continent, and could equally have collected either species. John Gilbert, the other collector later listed by Gray (1845), also visited both areas.

As the original description does not allow definite identification of the species, and as the type status

of neither purported 'syntype' is clear (neither accurately fits the single set of measurements, and their registration history has varied), I act to conserve the usage of Kluge (1974) and all subsequent authors by designating BMNH 1946.8.26.98, the specimen illustrated by Gray (1841), as neotype of *Delma fraseri* Gray, 1831a. This specimen has the following combination of characters: two pairs of supranasals, seven supralabials (fourth subocular), 7/6 infralabials, 5/4 loreals, 4/5 suboculars, two upper temporals, 15 nuchal scales, 14 gular scales, 16 midbody scales, three preanal scales and 73 ventral scales (caudal 56 transversely enlarged).

ii. A new subspecies of *Delma fraseri*

Kluge (1974) identified three South Australian specimens as *D. fraseri,* otherwise only known from south-western Western Australia, but did not note any significant differences between two of the eastern specimens and the western population. However, additional material of the eastern population now in hand has shown consistent differences between the two populations in number of midbody scales and strength of the throat markings, and extended the known range of the eastern form into Western Australia. Consequently, the eastern form is here given subspecific status.

Delma fraseri petersoni subsp. nov.
Figs 5–7

Holotype: SAM R20804, N end stock route (32°51′S 135°57′E), S.A., Nature Conservation Society, 13.x.81

Paratypes (11): SAM R3853, 15 mi. N Poochera, S.A., F. J. Mitchell, 15.vi.56; R10586, same locality, F. J. Mitchell, vi.56; R14985, 7 km W Immarna rail siding, S.A., C. and T. Houston, A. Edwards, J. Herridge, 7–9.xi.75; R20790, 2.5 km down stock route (32°53′S 135°57′E), S.A., Nature Conservation Society, 8.x.81; R20816, N end stock route (32°51′S 135°57′E), S.A., Nature Conservation Society, 11.x.81; R32259, Scrubby Peak area, S.A., G. Armstrong, 22.i.88; R32463, Middleback Ranges, S.A., South Australian Herpetology Group, 26.vi.87; R33681, Iron Duke, Middleback Ranges, S.A., G. Johnston, xi.81; WAM R100636, 20 km NNE Queen Victoria Spring, W.A., D. Pearson, 18.vi.87; R100930, 25 km NNE Queen Victoria Spring, W.A., D. Pearson, 21.i.89; R100964, Jumpbuck Rd, Plumridge Lakes, W.A., D. J. Pearson, 17.x.86.

Diagnosis

A large *Delma* (SVL up to 128.5 mm) differing from all other *Delma* in the combination of two pairs of supranasal scales, a dark head dorsally and laterally followed by a broad, dark nape patch (both reduced in intensity in adults), broad dark throat bands, a mode of 18 midbody scales, and 67–78 ventral scales.

Description

Rostral broadly projecting between rostral supranasals, apex gabled; rostral supranasal in broad contact with first supralabial; caudal supranasals present, in point to moderate contact with nostril; postnasal distinct, single; loreals 3–5 ($\bar{x}$ = 4.1, SD = 0.45, n = 24), usually 4 (79%), in single, unbroken series; preoculars 6–13 ($\bar{x}$ = 8.3, SD = 1.82, n = 23); suboculars 3–5 ($\bar{x}$ = 3.7, SD = 0.58, n = 21), usually subequal; supraciliaries 5–7 ($\bar{x}$ = 5.3, SD = 0.55, n = 24), usually 5 (75%), caudalmost large, medial to others; supraoculars two, first longer; supralabials usually 7 bilaterally with fourth below centre of eye (n = 11), rarely 8 unilaterally with fifth below centre of eye (n = 1); infralabials 6–9 ($\bar{x}$ = 7.0, SD = 0.62, n = 24), usually 7 (75%), first pair in contact on ventral midline, second pair separated; upper temporals two; occipital present, single; nuchal scales 15–17 ($\bar{x}$ = 15.8, SD = 0.72, n = 12); gular scales 15–18 ($\bar{x}$ = 16.7, SD = 0.98, n = 12).

Midbody scales usually 18 (n = 11), rarely 17 (n = 1); ventral scales 67–78 ($\bar{x}$ = 72.0, SD = 3.30, n = 12), cranial 14–18 ($\bar{x}$ = 15.9, SD = 1.24, n = 12) small, caudal 52–61 ($\bar{x}$ = 56.1, SD = 2.68, n = 12) transversely enlarged; preanal scales three; hindlimb scales 2–4 ($\bar{x}$ = 3.3, SD = 0.61, n = 24).

Snout-vent length 78–128.5 mm; tail length 264–317% of SVL (n = 4); hindlimb length 2.5–4.0% of SVL ($\bar{x}$ = 3.1, n = 12); head length (HL) 10.1–13.2% of SVL (n = 12), proportionally shorter in adults; head width 57.0–70.7% of HL ($\bar{x}$ = 64.6%, n = 12); head depth 42.0–55.3% of HL ($\bar{x}$ = 49.5%, n = 12); mouth length 81.4–89.1% of HL ($\bar{x}$ = 85.6%, n = 12); snout length 38.4–44.6% of HL ($\bar{x}$ = 40.1%, n = 12); eye diameter 11.5–14.3% of HL ($\bar{x}$ = 13.1%, n = 11); postorbital length 38.0–43.4% of HL ($\bar{x}$ = 41.1%, n = 11); rostral depth 11.4–14.3% of HL ($\bar{x}$ = 12.8%, n = 12); rostral width 20.2–24.4% of HL ($\bar{x}$ = 21.9%, n = 12); dorsal rostral length 6.9–9.6% of HL ($\bar{x}$ = 8.1%, n = 12); ventral rostral length 8.9–14.0% of HL ($\bar{x}$ = 10.4%, n = 12).

The holotype has the following combination of character states: caudal supranasal narrowly contacting nostril; four loreals; 8/7 preoculars, four suboculars, seven infralabials, 17 nuchals, 16 gulars, 67 ventrals (caudal 52 dilated), SVL 85 mm, TL 269 mm, HLL 2.7 mm, HL 11.2 mm, HW 7.2 mm, HD 5.1 mm.

Coloration (in preservative)

Body dorsally and laterally light grey-brown, often with slightly darker centres and lighter margins to scales, producing a series of narrow alternating light and dark stripes. Tail dorsum concolorous with body basally, yellow-brown distally. Head dorsally darker grey-brown from tip of snout to just caudal to parietals, and laterally touching rostroventral angle of ear, the caudal margin generally marked by small, irregular black patches. Dark hood followed by a light cream-brown or yellow-brown band, 3–4 scales wide, laterally crossing ear, in turn followed by a light to mid-grey nuchal band about 7–8 scales wide, touching caudodorsal angle of ear, with caudal edge convex, and cranial edge marked by small, irregular black patches. Body immediately caudal to dark nuchal band pale yellow-brown.

Dark cephalic hood invaded laterally by extensions of throat ground colour: an obscure

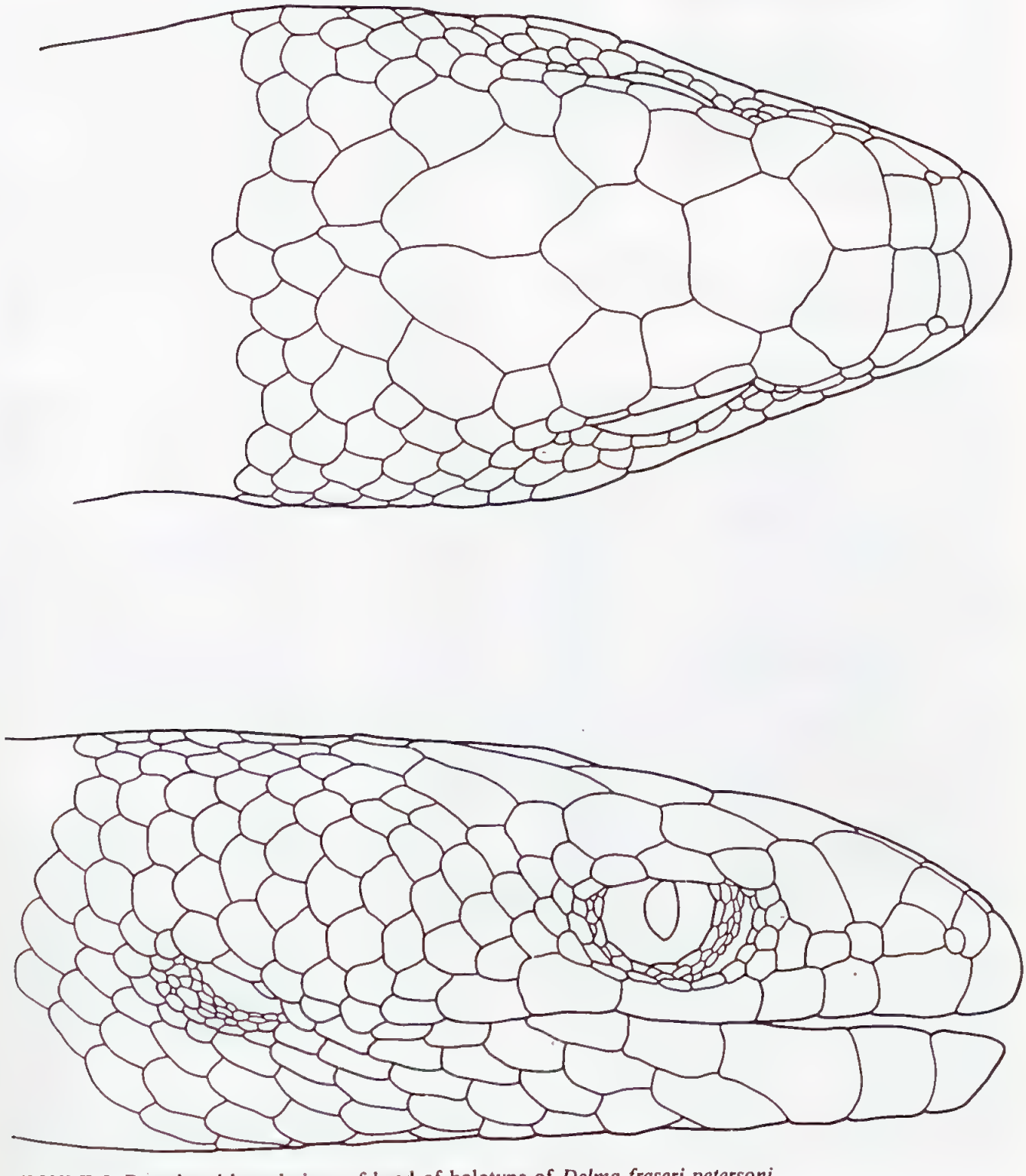

FIGURE 5. Dorsal and lateral views of head of holotype of *Delma fraseri petersoni*.

cream preocular bar and a broad triangular cream postocular bar. Laterally, dark nuchal band passes rostroventrally, narrowing ventrally, and is followed caudally by a broad triangular cream to orange-brown patch. Lateral ground on body and tail grades evenly into ventral ground.

Throat and chin cream, with dark grey bands, 2–3 scales wide, continuations of dark dorsal hood at level of orbit, rostral to level of ear, and caudal to level of ear, followed by one or two irregular bands not connected to dark dorsal markings. Dark bands often with irregular darker grey or black margins. First few infralabials usually with dark margins.

Body venter cream with grey margins to scales. Over caudal part of body and proximal part of tail, this grey perfusion almost completely covers the scales. Distal part of tail cream, generally immaculate.

Juveniles with similar pattern, but dark head markings solid black.

Distribution

Southern fringe of the Great Victoria Desert, and its extension eastwards to northern Eyre Peninsula and Middleback Range.

Comparison with other taxa

Delma f. petersoni differs from the nominate race in possessing a mode of 18 midbody scales (*vs* 16), and in having a strongly banded throat pattern. The throat pattern in adults of the nominate race consists of fine irregular dark variegations extending onto the throat from laterally (Fig. 6), unlike the broad complete bands of *D. f. petersoni.* Juvenile *D. f. fraseri* have stronger throat markings, often approaching those of adult *D. f. petersoni,* but the throat pattern of juvenile *D. f. petersoni* is even stronger, broad and evenly dark.

For comparative purposes, all material of the nominate race in the Australian Museum, British Museum (Natural History) and South Australian Museum was examined, together with Western Australian Museum material from the eastern extremity of the range. Comparative scale counts for this material in markedly variable characters were: loreals 3–6 ($\bar{x}$ = 4.1, SD = 0.50, n = 140), usually 4 (78%); preoculars 3–9 ($\bar{x}$ = 5.8, SD = 1.16, n = 136); suboculars 1–6 ($\bar{x}$ = 3.4, SD = 0.68, n = 136); supralabials usually 7, with fourth subocular bilaterally (n = 68), rarely 6 with third unilaterally (n = 1) or 8 with fifth unilaterally (n = 1); infralabials 6–8 ($\bar{x}$ = 7.0, SD = 0.44, n = 140); nuchals 12–17, ($\bar{x}$ = 14.1, SD = 0.93, n = 70); gulars 14–18 ($\bar{x}$ = 16.0, SD = 0.91, n = 70); ventrals 67–75 ($\bar{x}$ =71.1, SD = 2.09, n = 67); transversely enlarged ventrals 50–58 ($\bar{x}$ = 54.5, SD = 1.91, n = 50); midbody scales 15 (n = 1), 16 (n = 66), 17 (n = 1) or 20 (n = 1).

The distance between the easternmost records of *D. f. fraseri* and westernmost records of *D. f. petersoni* is approximately 235 km. The two races appear to differ in habitat preference, *D. f. petersoni* inhabiting mallee-*Triodia* habitats (see below), while *D. f. fraseri* inhabits a variety of less arid habitats, including woodland, heath and coastal dune complexes (Bush 1981; Chapman & Dell 1977, 1978, 1980a,b, 1985; Dell & Chapman 1977, 1978; Dell & Harold 1977; Storr *et al.* 1981).

Only three other *Delma* have a mode of 18 midbody scales: *D. australis, D. elegans* and *D. molleri. D. f. petersoni* is very much larger than *D. australis* (maximum SVL 128.5 mm *vs* 88 mm), and has two pairs of supranasals (*vs* one), loreal scale row uninterrupted (*vs* usually interrupted by prefrontal), ventral body scales transversely enlarged (*vs* equal in size to more lateral scales) and a broadly banded head pattern (*vs* finely variegated).

D. f. petersoni differs from *D. elegans* in having 67–78 ventral scales (*vs* 77–82), a broader snout, and the pale auricular band passing transversely across the entire width of the ear (*vs* angled obliquely along rostrodorsal margin of ear, and entirely separated from a second, postauricular pale bar extending dorsally from the throat to the caudoventral margin of the ear).

D. f. petersoni differs from *D. molleri* in attaining a larger size (maximum SVL 128.5 mm *vs* 111 mm), and in having two pairs of supranasals (*vs* one) and a strongly banded throat (*vs* immaculate pale throat).

The known distribution of *D. f. petersoni* overlaps those of only two other species of *Delma: D. australis* and *D. butleri,* all three having been taken at 15 mi. N. Poochera, S.A. Comparison with *D. australis* is made above. *D. f. petersoni* differs from *D. butleri* in having 18 midbody scales (*vs* usually 16), and a dark head (*vs* head concolorous with body) with strongly banded throat (*vs* immaculate pale throat).

Habitat

The limited habitat data associated with specimens suggests that *D. fraseri petersoni* is associated with *Triodia* habitats (Schwaner *et al.* 1985). The holotype was collected in a pitfall trap on a sand dune with spinifex and some *Callitris;* SAM R20816 in a pitfall in a dune system with *Triodia* and mallee; SAM R20790 in a pitfall in sandy soil with *Triodia* on the lower part of a dune slope, while SAM R14985 was taken from *Triodia* in an interdune flat with mallee. In Western Australia, WAM R100636 was taken from *Eucalyptus concinna* mallee over *Triodia basedowii,* and R100930 from marble gum woodland over *Triodia basedowii* on a yellow sandplain.

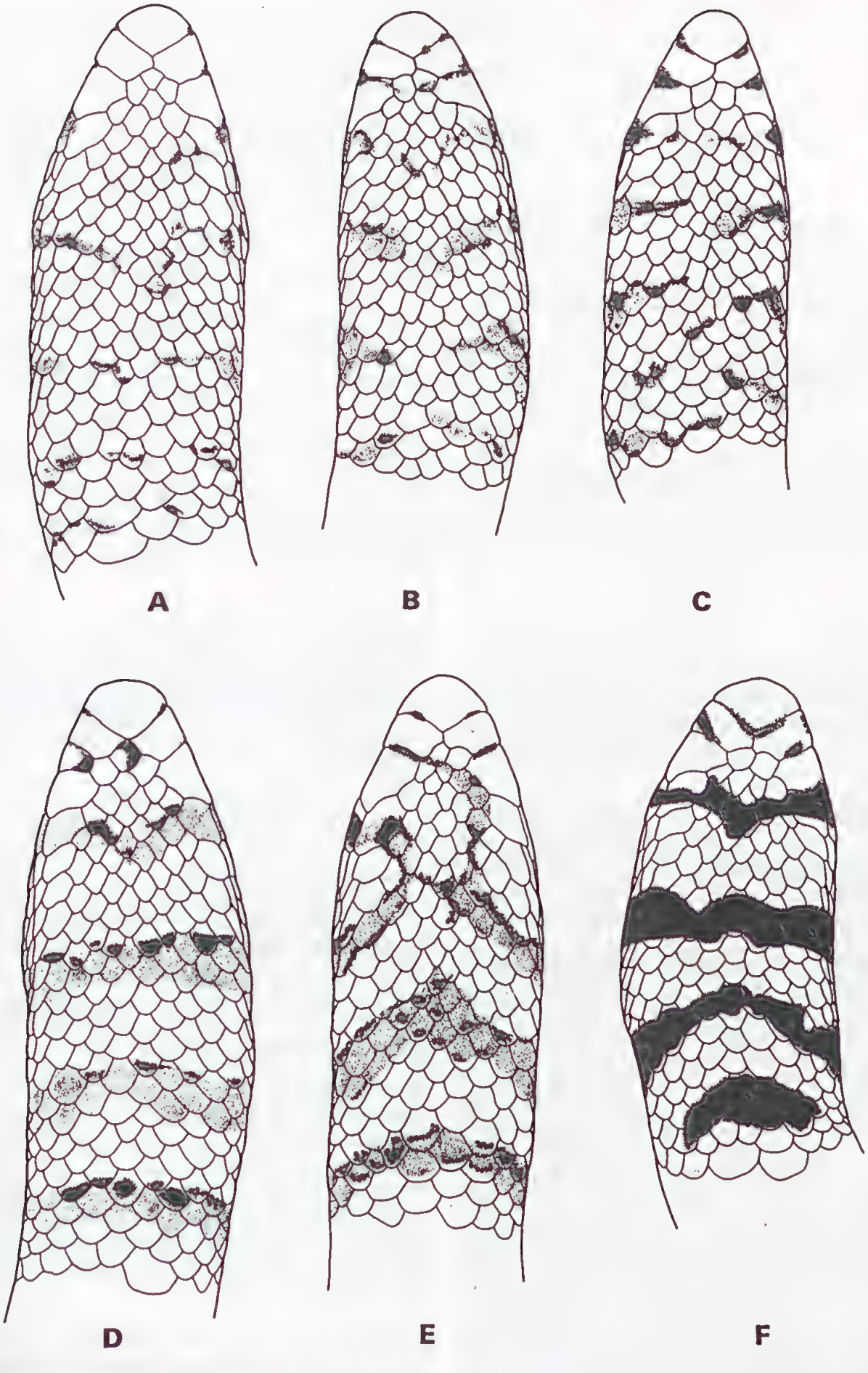

FIGURE 6. Comparison of throat patterns of *Delma f. fraseri* (A. AM R11115; B. AM R11651; C. AM R81700) and *D. f. petersoni* (D. SAM R14985; E. SAM R20790; F. SAM R33681).

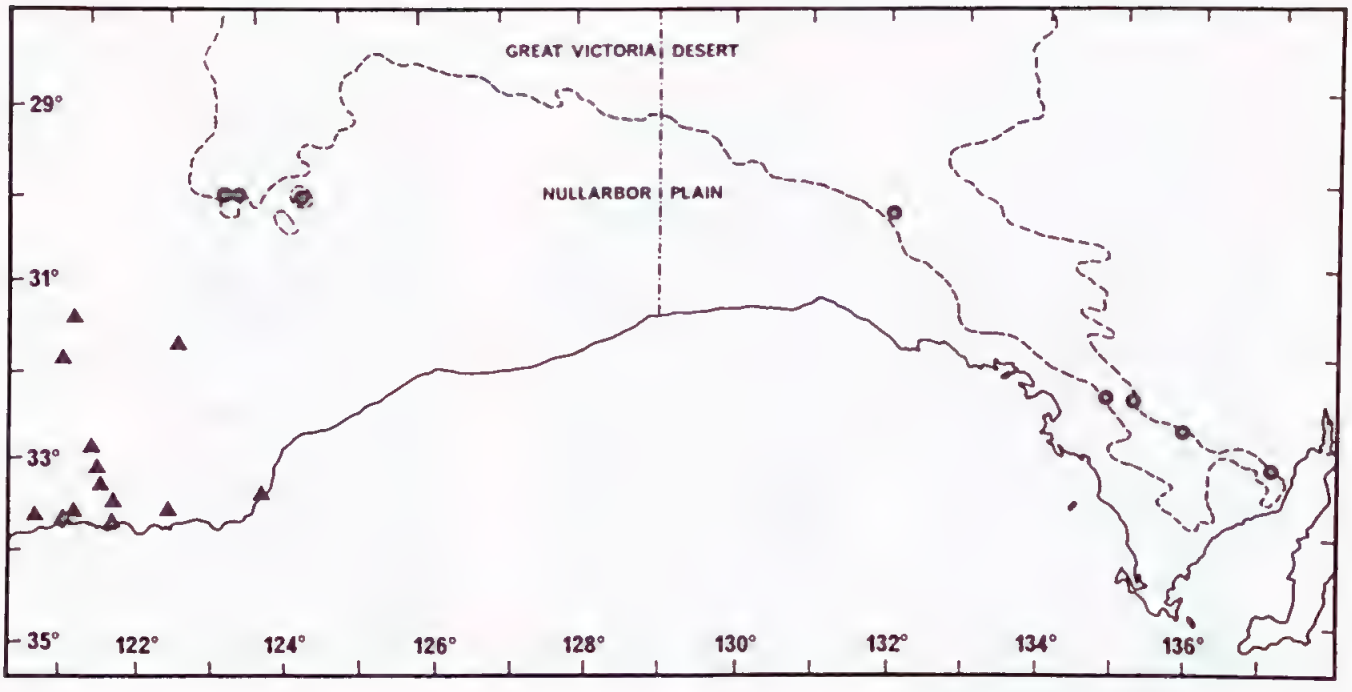

FIGURE 7. Distribution of *Delma fraseri petersoni* (dots) and nearest populations of *D. f. fraseri* (triangles). Dashed line represents approximate limit of sandridge systems of the Great Victoria Desert.

Etymology

Named for Magnus Peterson, of Perth, W.A., who initally prompted my interest in pygopodids, and who has continued to offer much discussion on their systematics and natural history.

Remarks

Although Kluge (1974) identified MV D2659 as *D. fraseri,* it agrees in all diagnostic characters with *D. butleri,* and lacks any trace of the dark head markings of *D. fraseri.* Consequently, I correct Kluge's identification of this specimen to *D. butleri.*

Comparative material of D. f. fraseri *examined* (all from Western Australia)

AM R2443–44, R2446, 'Perth, *etc.*'; R3436, Canning River, Darling Range; R9890, R9956, R10005, R11649–51, R11665, R131829–32, Tambellup; R11111–2, R11115, R12129–32, R131833, Woodlands, Tambellup; R81698, Esperance tip; R81699–700, 1.2 km E Ravensthorpe; R114824, Hopetoun; R131834, no locality; R133847, Esperance Chalet Village, end of Goldfields rd, NE Esperance; R133914, R133989–90, R134036, R134064, R134080, R134369, old rubbish tip just E Salmon Gums; R134273, SW side Grass Patch; R134372, vicinity of Scadden; BMNH 67.2.19.28,30, Champion Bay; 97.3.23.3, 1931.7.1.104–107, W.A.; 69.5.25.24–25, 69.5.25.29, Perth; 1966.411–412, Victoria Park; 1966.413, Bunbury; 1966.414, Wandering; 1966.416, Williams; 1966.417, Bengor; 1966.419, Nungarin; SAM R22828, WAM R75860–61, Lort River, Coomalbidgup; SAM R22911, Coomalbidgup tip; R22935, Burns Beach; R23258, 1 km N Wagin; R29406, 21 km N Geraldton; R29511–12, WAM R14786, Esperance; WAM R7463, Bodallin; R21993, 8 km E Gibson; R29660, Parker Range area; R29661–62, 43 km S Southern Cross; R31089, R31113, R66885, R67208, R67213, R93330–31, Israelite Bay; R36235–36, Munglinup; R37832, Split Rocks; R71179, North Ironcap; R72354, near Heartbreak Ridge; R86622, R86679, Lort River Station; R93557, Widgiemooltha; R95553, Condingup.

Delma impar (Fischer, 1882: 287).

Diagnosis

A moderate-sized species of *Delma* (SVL up to 101 mm) with single pair of supranasals, fused rostrally with first supralabial and caudally with postnasal, two preanal scales, and usually with a series of distinct narrow pale stripes laterally and dorsolaterally on body and tail, with series of dark spots between these stripes.

Description

See Kluge (1974).

Distribution

In South Australia, known only from the south-eastern border area (Fig. 8). The South Australian localities are at the western extreme of the distribution in Victoria and south-eastern N.S.W. (Kluge 1974).

Remarks

Kluge (1974) differentiated this species from other *Delma* primarily on the fusion of the supranasal to the first supralabial, a character not noted for

any other *Delma*. However, two specimens of *D. plebeia* I have examined (AM R12485, Qld; R98656, 5 km N Bulga, N.S.W.) show the same complex fusion of supranasal to both first supralabial and postnasal. These two species, together with *D. torquata,* share the derived character state of only two preanal scales, and may constitute a species group, the *D. impar* group, occurring in south-eastern Australia, especially in basaltic soils.

Specimens examined

Australian Capital Territory: AM R14349, Barton; R31621, Gungahlin.
New South Wales: AM R9639, nr Tumut; R11245, Gilmore; R64276, 14.5 km N Batlow at Wondalga (off old Tumbarumba rd).
South Australia: SAM R8387, R9977, R10060-61, R10715-22, R11143, R12666-68, Bool Lagoon; R8782, 3 mi. E Naracoorte.
Victoria: AM R8777, Mt Hope; BMNH 98.10.19.7, nr Melbourne.

Delma inornata Kluge, 1974: 101.

Diagnosis

A large species of *Delma* (SVL up to 135 mm) with modally 16 midbody scales, 1–2 pairs of supranasals, caudal pair (when present) moderately to broadly separated from nostril, and no dark head or throat markings.

Description

See Kluge (1974) and Shea (1987b).

Distribution

In South Australia, apparently restricted to the vicinity of Lake Alexandrina and the lower reaches of the Murray River (Fig. 8). Widespread in Victoria, N.S.W., and south-eastern Queensland (Shea 1987b).

Remarks

As noted by Shea (1987b), Kluge misidentified a number of specimens of *D. butleri* as *D. inornata.* To those misidentifications can also be added MV D15453-54, from Renmark (J. Coventry, *pers. comm.*). It seems likely that the South Australian population is isolated from the main part of the range of this species in N.S.W. and Victoria. The South Australian population has a high frequency of individuals with only a single pair of supranasals (78%, n = 9).

Habitat

Three specimens (R21001, R23870, R26138) were found under rocks. It is probable that the South Australian population inhabits open grasslands, like eastern populations (Shea 1987b).

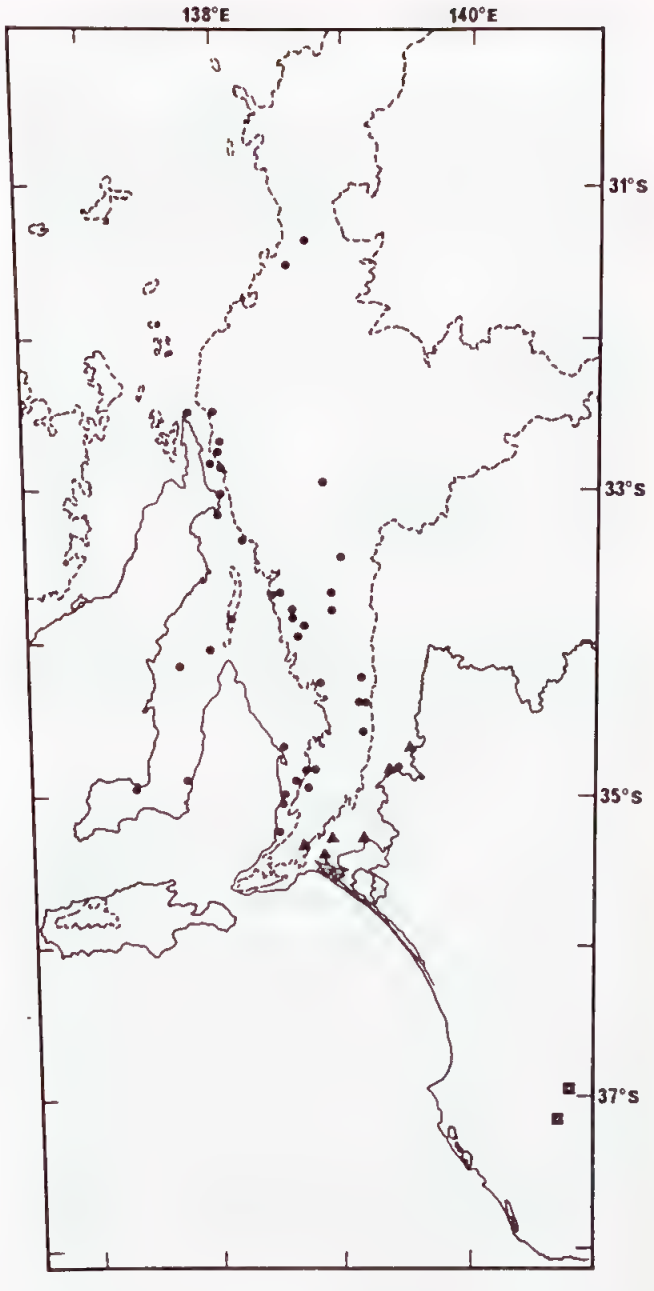

FIGURE 8. Distribution of *Delma impar* (squares), *D. inornata* (triangles) and *D. molleri* (dots) in South Australia. Dashed line represents 200 m contour.

Specimens examined

New South Wales: SAM R11095, 20 mi. N Walla Walla. See Shea (1987b) for other records from New South Wales and Victoria.
South Australia: SAM R12745, Tooperang; R17440, between Mannum and Purnong; R18648, 5 km N Walkers Flat; R18971, *ca* 16 km W Milang; R21001, River Marne; R23530, R23870, R26138, Lake Alexandrina; R32798, Strathalbyn.

Delma molleri Lütken, 1863: 296.

Diagnosis

A moderate-sized species of *Delma* (SVL up to 111 mm) with modally 18 midbody scales, a single pair of supranasals, dark dorsal head markings (of reduced intensity in large adults) and an immaculate pale throat.

Description

See Kluge (1974).

Distribution

Restricted to South Australia, to the Adelaide Plains and Yorke Peninsula and adjacent ranges, from the vicinity of Oraparinna H.S. in the north, east to 'between Mannum and Purnong' and south to Reynella (Fig. 8). The record from Hattah, in Victoria (AM R84295–96) is from a captive collection, along with other *Delma* specimens, and in the absence of any corroborating evidence is considered erroneous.

Habitat

Most specimens of this species for which data are available were found under rocks (n = 17), tin or other rubbish (n = 11) or timber (n = 2). A variety of vegetation types and topographies is inhabited, including 'sclerophyll scrub', 'tall grass in agricultural country', 'largely bare hills with occasional chenopods and mallees', '*Acacia*-scrub covered hilltop', 'eucalypt woodland on red soil with stones and sedges, scattered *Casuarina* and *Acacia* in understory', 'grass and rocky land adjacent creek', 'grassed sediment island in creek' and 'river flats'. Three of the Flinders Ranges specimens were taken in pitfalls in *Triodia* habitats.

Specimens examined (all localities except the first are in South Australia)

AM R84295–96, Hattah, Victoria [in error]; R89125, Peterborough; R115770, 3.3 mi. W Kulpara on Paskeville rd; R115813, 34°11′S 137°41′E, Yorke Peninsula; R115928, 2.5 mi. W 'Tracy'-'Caroona' rd on Mt Bryan rd; R115939–40, 4.2 km NW Mintaro on Hilltown rd; R115943–44, 33°40′S 138°30′E; BMNH 92.5.18.1, S.A.; 1923.11.11.47, SAM R1470, R12672–73, Mt Lofty; BMNH 1962.810, Morialta; 1962.811, Clare; SAM R1584, R16056, Black Hill; R2233, Mt Lofty Range; R3021, Dunstone Quarry, Burnside; R6362–70, few miles N Burra; R8140, Hummock Mt; R11186–87, 1 mi. NE Tea Tree Gully; R12514–15, N of Wilmington, on towards Mt Brown; R12550, 4 mi. E 1 mi. N Truro; R12591, 2.5 mi. S 2.5 mi. W Stansbury; R12624, R12671, Point Turton; R12918, Mambray Creek; R13150, Seacombe Gardens; R14028, Mambray Creek National Park; R14462, Mt Brown; R14656a–b, 26.5 km N 5 km E Burra; R15625a–b, 3 km E Truro; R16006, nr Port Augusta, on old Port Augusta-Wilmington rd; R16952, *ca* 5 km S Wilmington; R16954, Mt Remarkable National Park; R17464, Hallet Cove Conservation Park; R17642, between Mannum and Purnong; R17943, R25360, Wilpena Pound; R18856, 6 km SE Keyneton, nr Sedan Hill; R19018, 5 km N Clare; R20581, Burra Creek Picnic Reserve; R20825, 8 km N Auburn; R22539–40, Telowie Beach; R22787, R23088, R23106, Mt Remarkable National Park, 2.1 km E Sugargum Lookout; R23136–37, R23139, R23144, Mt Remarkable National Park, 2.6 km from Scarfe's Hut; R23143, Mt Remarkable National Park, Alligator Gorge; R23894, St Kilda; R24200, 14 km S Burra; R24208–10, 11.2 km N Dutton; R24211–14, 1 km S Burra; R24862, nr Oraparinna HS; R25786–87, Reynella, R26121–22, Pt Pirie; R28362, R28628, Bowman Park Recreation Reserve; R30310–14, Rochester Historic Site; R31718, Aldinga; R32858, Para Hills; R32889, Anstey Hill.

Delma nasuta Kluge, 1974: 109.

Diagnosis

A moderate-sized species of *Delma* (SVL up to 112 mm) with usually 16 or more midbody scales, fourth supralabial below centre of eye, long narrow snout (Fig. 3), usually five or more loreals, dorsal scales pale brown with a dark apical spot, and ventral scales usually basally edged with dark brown.

Description

See Storr (1987) and Storr *et al.* (1990).

Distribution

Arid *Triodia* habitats of Northern Territory, south of Spring Creek, Barrow Creek and 'Fish River', and far north-west corner of South Australia (Fig. 9). Also occurs in western Queensland (Shea 1987a) and northern and central Western Australia (Storr 1987).

Habitat

Like other populations (Kluge 1974; Storr 1987), Northern Territory populations of *D. nasuta* are apparently *Triodia* inhabitants. The six specimens for which microhabitat data are available were found in *Triodia*. One specimen (AM R80364) was found active on a road at 2020 hrs.

Specimens examined

Northern Territory: AM R12013, Mt Gillen; R80364, 33 km S Barrow Creek; R84566, 50 km S Alice Springs on Stuart Hwy; R120116, Dead Bullock Plains, 'Tempe Downs'; R130666, 5 mi. W 'Narwietooma'; BMNH 1973.3286, Kintore Range (23°22′S 129°26′E) (formerly JSE 305); CAWC R10, Hermannsburg; R20, 'Fish River'; CAWC R301, NTM R1590, R1601, R1869, R1871–72, R1891, Maryvale; CAWC R764, Yuendemu Settlement; R919, 20°02′S 130°16′E, Tanami Desert; R1062, Bonney Creek, 'McLaren Creek'; R1322, Ayers Rock; R1463, 23°52′S 135°42′E, Simpson Desert; R1494, 'Todd River'; R1647, Trephina Gorge; R2003–05, R2013, 'Tempe Downs'; R2008–09, George Gill Range; R2010, Ooraminna; R2011–12, Mt Peachy; NTM R1593, 20 km N Maryvale;

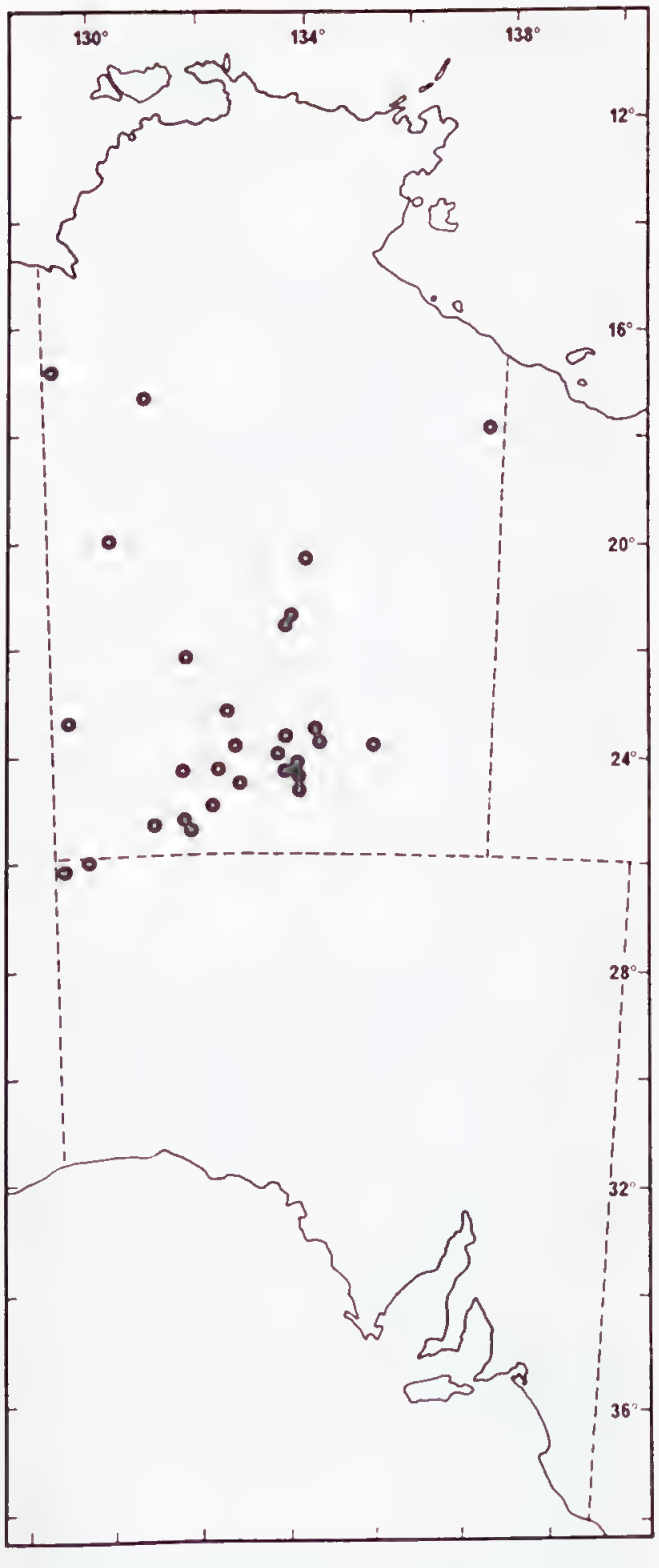

FIGURE 9. Distribution of *Delma nasuta* in the Northern Territory and South Australia.

R1621, 28.5 mi. S Alice Springs; R5568, SAM R18721, Alice Springs; NTM R5829, 'Wave Hill'; R6556, Barrow Creek; R12733–34, 'Tempe Downs', 25 km N Kings Canyon rd; SAM R29889, 7 km along 'Mulga Park' rd, SSE 'Curtin Springs' H.S.; R29940, 22 km along 'Mulga Park' rd, SSE 'Curtin Springs' H.S.; WAM R20816, 'Angas Downs'; R24354, 6 mi. SW Barrow Creek; R55348, R55398, 'Maryvale' H.S.; R60234–36, Spring Creek, 58 km N 'Wave Hill' H.S.

Queensland: AM R26010, Mt Isa; R49667, 193.7 km N Windorah; R110542, R110609, 14 km NE Scott's Tank, 'Diamantina Lakes'; R125040, between Mt Isa and 100 km to NW.
South Australia: AM R17310–15, R17376, R17646, R17939, Mt Davies, Tomkinson Range; R17535, Mann Range.
Western Australia: AM R105732–34, 28.3 km N 'Nanga' turnoff on Denham rd; R111132, SAM R13444, Wittenoom Gorge; CAWC R452, Balgo Mission; R1429, Giles Meteorological Station; NTM R6664, Nicholson River Gorge, 'Nicholson'; R6762, 16.3 km N Halls Creek; R7035–37, between Fitzroy Crossing and Halls Creek; R7282–85, 167 km E Fitzroy Crossing; SAM R12675, Warburton Range; R29375, 34 km S Denham; R29379, 24 km S Denham.

Delma tincta de Vis, 1888: 824.

Diagnosis

A small to moderate-sized species of *Delma* (maximum SVL 92 mm), with usually one pair of supranasals, third supralabial in subocular position, 14 midbody scales and, in juveniles and subadults at least, a dark head dorsally and laterally, with narrow pale bands (one preocular, one postocular, one auricular, one nuchal), but mid-throat region immaculate, pale.

Description

See Kluge (1974) and Storr *et al.* (1990).

Distribution

Southern two-thirds of Northern Territory, south of 'Wave Hill', Tennant Creek, 'Anthony Lagoon', Borroloola and 'Bing Bong', with possible isolates further north in the Katherine district (one specimen) and far northern coast (Yirrkala to Oenpelli, and possibly as far west as Humpty Doo). In South Australia, apparently restricted to the north-eastern quarter, extending south-west to 'Erudinna' (Fig. 2).

Also widespread in Queensland and northern N.S.W. (Shea 1987a) and central-west Western Australia and the Kimberley (Storr *et al.* 1990).

Remarks

Kluge (1974) reports widespread sympatry of *D. borea* and *D. tincta*. This does not appear to be the case in the Northern Territory or Queensland. Rather, they seem to have largely complementary distributions. In the Northern Territory, the two species have been collected in close proximity only at 'Wave Hill' (five *D. borea*) and old 'Wave Hill' (one *D. tincta*), in the Katherine district (three *D. borea* from Katherine and district, one *D. tincta* from Katherine Farms rd and another from 'Katherine district'), at Humpty Doo (one *D. borea* and one *D. tincta*, the latter from 'Humpty Doo district'), and in the Alice Springs area (two *D. borea*

from Heavitree Gap, one from Alice Springs, 35 *D. tincta* from Alice Springs). At Yirrkala, three specimens are typical *D. borea* in all three scalation characters, while one specimen has the single pair of supranasals and third supralabial subocular of *D. tincta,* but the 16 midbody scale rows of *D. borea,* the latter character only otherwise seen once in 111 Australian Museum *D. tincta.* Further collections are needed to determine whether this specimen is really *D. tincta,* or an aberrant *D. borea.* Only in the case of two specimens (NTM R3791-92) from 'Katherine district' have the two species been possibly collected synchrosympatrically.

The single record for Renmark (NTM R1166) is considered to be erroneous. The Renmark area is otherwise well-known herpetologically, and over 325 km south of the next nearest record.

Habitat

In the N.T. and S.A., specimens have been recorded under rubbish (n = 7), in leaf litter (n = 5), under dead *Triodia* (n = 2), under rock (n = 1) and in a disused ant nest under a rock (n = 1). Habitats included grassland (n = 3), mulga plain (n = 1), red soil plain (n = 1) and black soil plain (n = 1). Four specimens were found active on roads between 1915 and 2100 hrs, while one was active in long grass at 1300 hrs.

Specimens examined

New South Wales: AM R4123, Clarence River; R16683, R60469-72, Bingara; R18582, Croppa Creek; R32595, 'Harriearra', via Tibooburra; R44737, junction of Teatree Creek and Horton River, 30 km WSW Bingara; R51703, 13 mi. E Manilla on Retreat rd; R51704-05, 0.7 mi. S Woolomin; R63985, 2 mi. S Barraba; R64330, Yalleroi; R86219, 'The Brothers', North Star; R87537-45, Moonbi Lookout; R104309, Tamworth; R105969, Chunky Creek, 'Mt King'; R107713, Moree; R110672, nr Menindee; R118978, R129322, Manilla Tip.

Northern Territory: AM R11529, Plenty River; R12364, Yirrkala; R26398, nr Peterman Ranges, 61 mi. from W.A. border; R26477-78, R26499, vicinity of Finke; R31624, Smoke Hills, Tanami Desert; R50963, CAWC R11-17, R1070, R1350, R1561, R1805-06, R2232, R2341, R3021, R3124, R4806, R5448, R5889, R5909-10, NTM R531, R5558, R5563, R5567, R8621, Alice Springs; AM R52131-32, R52134, Greenleaves Caravan Park, Alice Springs; R52133, Alice Springs Airport; R54923, 65 km upstream from sea, Liverpool River; R54924, 20 km upstream from sea, Liverpool River; R55355, 'Bing Bong', via Borroloola; R80363, 20 km W Qld/N.T. border on Barkly Hwy; R80368, 29 km E Three Ways on Barkly Hwy; R84549, 25 km N Alice Springs on Stuart Hwy; R84565, Henbury Meteorite Reserve, 146 km N Kulgera on Stuart Hwy; CAWC R291, 10 km N Deep Well; R495, Borroloola; R502, NTM R6484-86, R8416-18, R8513, R8811, Frewena Roadhouse and vicinity; CAWC R622, 'Alexandria' H.S.; R1205, R1212, Maryvale; R1262, R1330, Simpsons Gap; R5909, St Phillips College, Alice Springs; NTM R101, Katherine Farms rd; R700, Railway Yards, Alice Springs; R910, Oenpelli; R1573-74, Tanami Bore; R1861, Mt Gillen; R2467, Bradshaw Drive, Alice Springs; R3679-80, 'Brunette Downs' H.S.; R3792, Katherine district; R5278, Telecom Building, Alice Springs; R5391, Mt Watt, *ca* 25 mi. NW 'Horse Shoe Bend'; R5392-93, Mt Sunday Range, 190 km S Alice Springs; R5742, Whycliffe Well; R6557, 10 km N Alice Springs; R6622, old 'Wave Hill' H.S.; R8544-51, R9557-64, Alroy Downs; R8557, 64 km N 'Alroy Downs'; R8604, 7 km N Three Ways; QM J21786, Humpty Doo district; J26982, MIM mine, MacArthur River; SAM R8062, Tennant Creek; WAM R55406-07, R55440, 71 km W Barry Caves; R78239, 70 km W Barry Caves.

Queensland: AM R2283, Bloomfield River, Cooktown; R5853, Oakey; R7003, R10237, R84394, Cooktown; R9361, 118 mi. N Rockhampton; R9453, Winton; R11653, Cunnamulla district; R12321, Proserpine; R13010, Hughenden; R13801, Townsville; R17028, Laura; R17080, Gregory Springs via Hughenden; R31628, R31631, Mt Isa district; R37484, 15 mi. from Proserpine on Shute Harbour rd; R12201-02, Brooklyn, Winton; R13714, Mungai Junction; R16347, R16684, R16686, 'Silver Plains'; R16671, Lappa Junction; R21131, Cunnamulla; R50209, 'Tullochard', 78 mi. SW Mitchell; R51524, Grassy Hill, Cooktown; R55612, R58482, 'Gilruth Plains'; R56816, 10 mi. S Gayndah; R60249, 1.6 km E Camooweal; R61577, Lizard Island; R62301, 80.1 km N Muttaburra on Hughenden rd; R62459-62, R62706, 62.4 km N Muttaburra on Hughenden rd; R62490-95, *ca* 23.7 km NW Aramac turnoff via Muttaburra rd; R63056, Clermont; R63110, WAM R21420-22, Charters Towers; AM R63333, Croydon Tip; R63431, just NE Karumba; R63574, 0.7 km S airport entrance via old Croydon rd; R63615-17, 8.1 km W Croydon rd; R63692, 23.9 km E Croydon P.O. via Gulf Hwy; R63714, Crooked Creek at Gulf Hwy, 34.5 km W Georgetown; R81701-02, 6.6 km SE Greenvale by rd; R81703, Charters Towers Tip; R81704, 25.2 km N Yeppoon via Byfield rd; R84404, 22.0 km S Townsville on hwy; R90213, 63 km W Winton on Boulia rd; R90214, 55 km SE Winton on Landsborough Hwy; R105152, Weipa regeneration area; R113228-29, Mayne Junction Bore, 'Diamantina Lakes'; R128219, R128857, Mandalee, Innot Hot Springs; BMNH 1924.3.3.22-26, 'Alice Downs', Blackall.

South Australia: NTM R1166, Renmark [in error]; SAM R14498, Flinders Ranges; R15189a-c, 'Erudinna'; R18254, R18262-63, R32453, Coongie Lake; R30970-71, 'Coongie'; R30976, 8 km SSE 'Coongie'; R31173, 27°12'S 140°08'E, Cooper Creek area.

Western Australia: AM R4939; R40529-30, NTM R13084, 3 mi. S main Ord River Dam; AM R100565, 26.9 km N Wittenoom-Newman rd via Port Hedland rd; NTM R9940-41, Wyndham.

No data: NTM R331, R2973, R9855-57.

A Key To The *Delma* Of South Australia And The Northern Territory

1 — Ventral scales not transversely enlarged; loreal scale row usually interrupted by prefrontal scale.... ..... *australis*

— Ventral scales transversely enlarged; loreal scale row complete, prefrontal separated from supralabials 2

2 — Single pair of supranasals, fused with first supralabial rostral to nostril and with postnasal caudal to nostril; two preanal scales.....*impar*
— First supralabial and postnasal distinct from supranasals; three preanal scales.....3
3 — Usually 14 midbody scales; third supralabial scale subocular; one pair of supranasals.....*tincta*
— Usually 16 or more midbody scales; fourth supralabial scale subocular; one or two pairs of supranasals.....4
4 — Upper temporal single; size small (SVL ≤98 mm); head dark (paler in large adults) with narrow light bands; throat pale, immaculate.....*borea*
— Upper temporals two or more; size small or large; head pale or dark; throat with or without dark variegations.....5
5 — Usually 18 midbody scales; head darker than body (contrast reduced in large adults).....6
— Usually 16 midbody scales; head concolorous with body.....7
6 — One pair of supranasals; throat immaculate.....*molleri*
— Two pairs of supranasals; throat with dark bands.....*fraseri petersoni*
7 — One or two pairs of supranasals; if two, caudal pair broadly separated from nostril.....*inornata*
— Two pairs of supranasals, caudal pair narrowly separated from nostril.....8
8 — Snout long, narrow; colour pattern (when present) of dark spots dorsally and ventrally....*nasuta*
— Snout short; colour pattern (when present) of irregular complete or incomplete narrow pale bands over head.....*butleri*

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'LI-MARAMARANJA': YANYUWA HUNTERS OF MARINE ANIMALS IN THE SIR EDWARD PELLEW GROUP, NORTHERN TERRITORY

JOHN J. BRADLEY

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For many generations the Yanyuwa people in the Gulf of Carpentaria have hunted dugong and sea-turtle. Despite external pressures the skills and traditions associated with hunting these marine creatures have survived. These traditions continue to provide a sense of pride within Yanyuwa society.

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The Yanyuwa group of Aboriginal people who live in and around Borroloola, Northern Territory in the south-western Gulf of Carpentaria pride themselves on being hunters of dugong *(Dugong dugon)* and sea-turtle (usually the green turtle *Chelonia mydas*). This pride is based both on historical association and the continuing spiritual identification with these marine animals. In Yanyuwa society certain people are regarded as being *maramaranja,* a term which can be translated as 'a dugong and sea-turtle hunter of excellence'. As the following song verse suggests, it is a title of which individuals and their associated families are proud:

Wirndalbirndal
ngamabala-wada
ndi-ngambala li-wurralngu
li-Maramaranja.

Long and strong
is our hair,
for we are inhabitants
of the sea country:
we are dugong hunters
of excellence.
(composer: Jack Baju 'Akarrunda')

The Yanyuwa hunt the dugong and sea-turtle in the shallow waters about the Sir Edward Pellew Group, the mouth of the Carrington Channel and the mouths of the McArthur, Crooked and Wearyan Rivers in the Northern Territory (see Fig. 1). It is in these shallow waters that various species of sea-grass are found. Both dugong and sea-turtle feed on sea-grass. The Yanyuwa classify the sea-grass into that which is eaten by the dugong and that which is eaten by the sea-turtle. In fact both animals eat sea-grass of the same *Halophila* species (Dr I. Poiner pers. comm.). The names given to sea-grass by the Yanyuwa are as follows: *maraman* and *malhanngu,* which is said to be eaten by dugong, and *na-wirrilbirril* and *na-julangal* which is said to be eaten by sea-turtles. A general term for all sea-grass is *ki-maramanda.*

Yanyuwa Terms For Dugong And Sea-Turtle

Yanyuwa hunters possess a rich and complex knowledge of the dugong and sea-turtle. This knowledge concerns both the factual details concerning the sea-turtle and dugong, and the deep spiritual significance which governs how the Yanyuwa act towards these animals. The Yanyuwa classify the dugong and sea-turtle into the following categories:

Dugong

General terms

walya – general term for both dugong and sea-turtle.
waliki – general term for dugong.
nhabal – avoidance term for all dugong.
yiwaji – archaic term for all dugong.
wundunyuka – general term for all sea-turtle.
li-waliki/a-waliki – a herd of dugong.

Female terms

a-banthamu – old cow with small tusks visible.
a-bayawiji – mature cow, capable of breeding (no tusks).
a-ngayiwunyarra
a-kulhakulhawiji –pregnant cow.
a-lhumurrawiji –pregnant cow with a calf still following.
a-miramba – non-lactating cow, but with a large calf still following.
a-ngarninybala – cow with her calf riding on her back.
a-wurduwu – young female dugong.
li-milkamilarra – small group of cows with calves.
nyanki-ardu – dugong foetus.

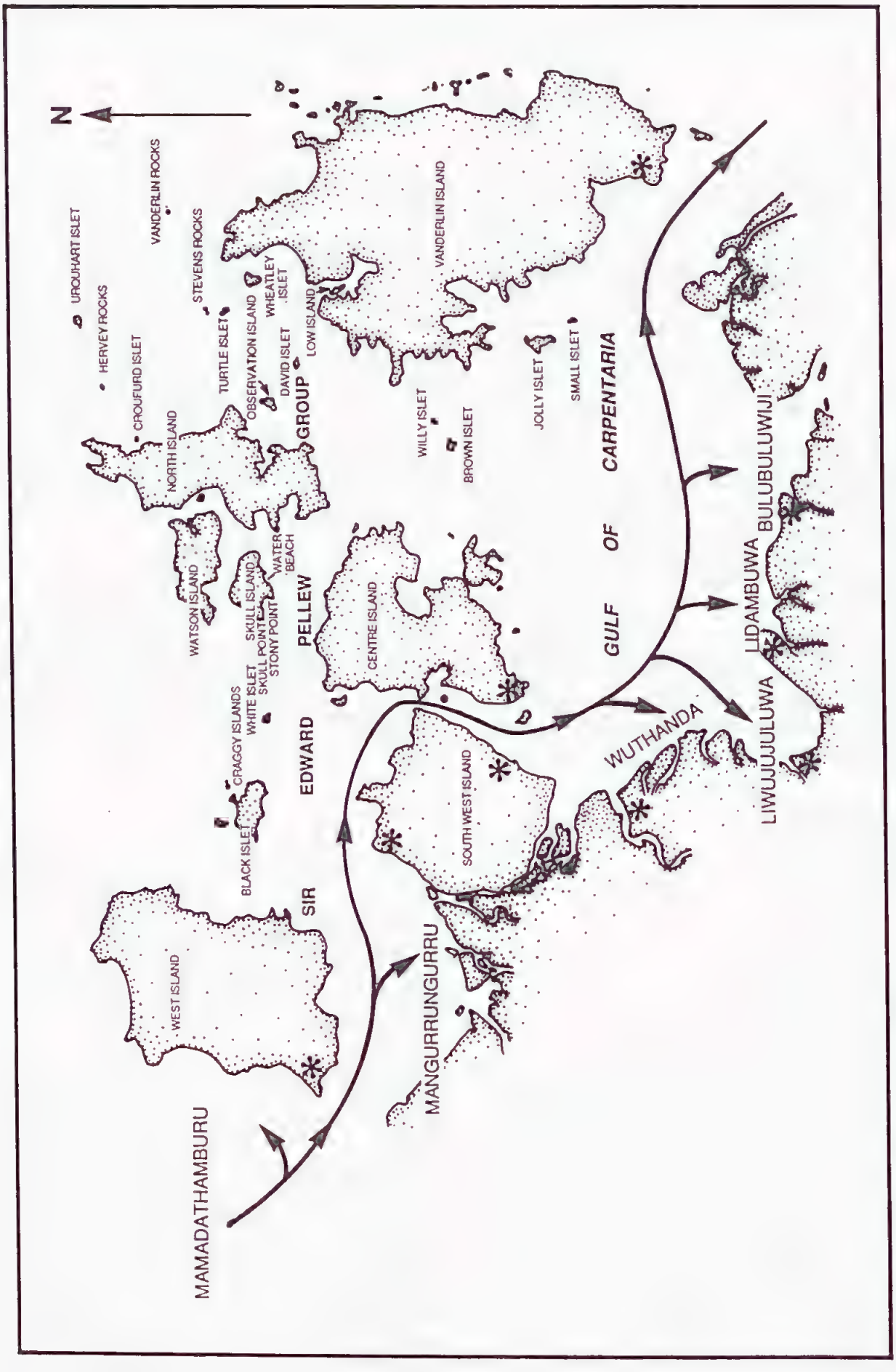

FIGURE 1. Map showing dugong migratory path (arrowed line), and favoured dugong hunters' base camps (asterisks).

Male terms

bungkurl – very fat, small male dugong.
jiyamirama/jiwarnarrila – male dugong which travels away from cow during times of threat.
mayili – bull dugong with small tusks.
rangkarraku/rangkarrangu – bull dugong travelling by itself.
wiriji – large old bull with a mottled hide, considered to be the offspring of the Rainbow Serpent.
wirumantharra – bull dugong whistling, often said to be the leader of the herd.
ngumba – very young dugong.

Sea-turtle

There are three species of turtle in the area of the Pellew Islands. The most commonly hunted is the green turtle (*Chelonia mydas*).

Green turtle

malurrba – green turtle.
warrikuliyangu – male green turtle.
ngulululurru – male green turtle.
rra-tharra – female green turtle.
a-wandangumara – very large female green turtle.
bankiba – very large male green turtle.
ngajilingajili – green turtle with a light coloured shell and a lot of yellow colouring to the underside.
lijalijangulyanda – young green turtle not considered big enough to eat.
a-wathawayawiji – female green turtle containing unlaid eggs.
yabalarla – green turtle hatchling.
ngarrangarra – green turtle which lacks a lot of body fat.
wunakathangu – green turtle found with ulcerations in the stomach (not eaten).

Flat-backed turtle

wirndiwirndi – flat-backed turtle. This species of sea-turtle is occasionally captured by Yanyuwa hunters.
jadiwangarni – male flat-backed turtle.
a-karninja – female flat-backed turtle.

Hawksbill turtle

karrubu – hawksbill turtle. This species is not captured by the Yanyuwa as it is considered poisonous.
yibarriwuna – male hawksbill turtle.
a-ngurrin – female hawksbill turtle.

Loggerhead turtle

limarrwurrirri – loggerhead turtle.

General terms relating to turtles

rri-bankuja – mating turtles.
rujurru – turtle hatchling.
ngangkurrurru – female on the beach laying eggs.

DUGONG AND SEA-TURTLE HABITATS

The hunters of dugong and sea-turtle know that it is the tides which primarily affect the movement of dugong and sea-turtle. Both animals feed on the coastal sea-grass beds at high tide (*ngakan*) and move out onto the off-shore beds at low tide (*mangkuru*). A turning tide (*jalababa*), is often considered a good time to hunt dugong especially if the tide is coming in as the dugong will be travelling in towards the sea-grass beds. If the sea is calm both dugong and sea-turtle can occasionally be seen feeding on the sea-grass beds along the more exposed coastal and reef areas.

The Yanyuwa men who are versed in the 'Law' of the dugong say that the dugong is a migratory animal. This migratory path would seem to range from just south of the Limmen River mouth, through the Pellew Islands and eastward to the region of the mouth of the Robinson River. Dugong are classified into two groupings; there are those that are continually moving and those which are more territorial. In the Yanyuwa language the migration of the dugong is known as *muyu,* and those dugong who remain in one area are called *jibiya baji* or 'countrymen belonging to that place'.

In the area of the Sir Edward Pellew Group the dugong migration path would seem to run south of West Island to the north of South West Island and into the small strait between South West Island and Centre Island, then eastward past the mouths of the McArthur and Wearyan Rivers.

Both the dugong and sea-turtle frequent the same areas, due to the presence of the sea-grass beds. The Yanyuwa do not regard the sea-turtle as a migratory animal, though research has shown that the green turtle does migrate long distances to nest (Limpus 1985 pers. comm.).

The localities which dugong and sea-turtle are known to frequent are the south-west and central west coast of West Island (Mamadathamburu), the area in the vicinity of the central west coast of South West Island (Mangurrungurru), the McArthur River mouth and Dugong Creek (Wuthanda), an area around the mouth of the Crooked River (Liwujujuluwa), an area to the north-east of Sharkers Point (Lidambuwa), and an area to the north of the Wearyan River (Bulubuluwiji). At most times of the year dugong and sea-turtle can be found at any of these localities in varying numbers (see Fig. 1).

The largest numbers of dugong are found in the vicinity of the Sir Edward Pellew Group in the mid dry season (*ngardara*), usually around June, July and August. It is during this time that the Yanyuwa do the greater part of their dugong and sea-turtle hunting, though people will hunt at other times of the year. During the mid dry season however, the

sea is usually calm and the strong south-easterly winds (*rra-mardu*) have ceased to blow.

Harpooning Equipment

Yanyuwa hunters prepare or repair most of the equipment detailed below while still at camp or while travelling on the river on the way to the sea (see Fig. 2).

The Yanyuwa hunt dugong and sea-turtle with a harpoon with a detachable head to which is attached a long rope and float. Most senior Yanyuwa men possess at least one harpoon, which is called either *na-ridiridi, yirlakungka* or *ratharr.* These are usually carved from the wood of young messmate trees (*Eucalyptus tetrodonta*) and are from three to five metres in length. The harpoons are usually well cared for, being rubbed with the sap of certain trees, red ochre and sugar bag wax to help preserve them.

The base of the harpoon point rests in a socket carved into the thicker end of the harpoon shaft. This socket is called the *na-wuthula* or *na-balalarra,* or more commonly *na-mulu* ('its mouth'). The harpoon points are usually called *na-malbi* or *na-wulukayangu* and today are made of metal – usually a piece of steel rod (tappet rods from Toyota engines are a common source), approximately 15 cm in length and 1 cm in diameter. In past times these points were made out of hardwood, usually *Pemphis acidula,* which in Yanyuwa is called *na-wubulu.* These wooden points were warmed slowly in the hot white ashes of a fire to temper them. In past times the wooden points used for hunting sea-turtle were barbed because the hunters had to spear the turtle in the neck or flippers, as the wooden points could not penetrate the shell. These barbed wooden points were called *na-ngalhinbiji* which literally means 'it has a hook/barb'.

The top of the harpoon point is wrapped in cloth or paperbark and then tightly bound with string to ensure that the harpoon point rests firmly in the harpoon. The harpoon point is attached to the harpoon ropes called *ma-ngarduku* or *ma-yinymathu.* In the past the rope was made out of the inner bark of the kurrajong or banyan tree. Today commercial nylon or hemp rope is used. Kurrajong ropes are still occasionally made for sale to Aboriginal art and craft organisations.

Two ropes of about twenty metres in length are required. The harpoon point is attached to the rope by way of the *nungawu,* which is a small loop made in the end of the rope through which the harpoon point is passed. The bound end of the harpoon point is pushed firmly against the loop and then both are tied together with string. The other end of the ropes are attached to a wooden float called *mawarl.* This is made from a light piece of wood and is usually about 60–70 cm in length and about 20 cm in diameter. The float is thrown out when a dugong or sea-turtle is harpooned, to mark the course the harpooned animal takes and to tire it out. This float was of more importance in the days of bark and dugout canoes when men had to paddle to catch their prey. With the advent of motor boats the hunters can usually keep up with the sea-turtle or dugong and the float is rarely required but it is always carried and kept attached to the ropes. The float is still useful if the engine fails, the rope becomes tangled, if the hunter falls overboard when he spears the dugong, or loses the harpoon.

It is Yanyuwa tradition that the dugong and sea-turtle be harpooned twice. The first harpoon strike into the dugong is called *na-walangkarramba* or *na-walangkarrangu,* and the second is called *na-nyirriwa* or *na-nyirriwangu.*

Hunting Rules

Yanyuwa dugong hunters must follow strict rules before leaving the land to go hunting. Hunters try to keep their noise level to a minimum, they will not break sticks, burn string or sugar bag wax or handle greasy food. The reasons behind these restrictions are not known but the restriction on making noise is said to be because the dugong has extremely keen hearing. In Yanyuwa the dugong is said to be *lingi,* a term usually reserved for a person of high intelligence or keen hearing. It is believed that if too much noise is made the dugongs will hear and dive into deep water where they cannot be hunted. Men will not handle greasy food before hunting as they believe if it contacts the harpoon points it will make them smooth and they will slip out of the harpooned dugong or sea-turtle. All of these restrictions are grouped together under the generic term, *wardimalyurr.*

While there are no such specific rules associated with the hunting of sea-turtle, this animal's keen eyesight is treated with as much respect as the dugong's acute hearing. Otherwise, the same rules are observed as the hunters do not know which of the two animals they may find when setting out on an expedition. Any person who disregards these restrictions and others concerning the Law of the dugong have the following phrase directed at them — *wardiwiji angkawangu* ('you are filled with badness, you are a mainland dweller'). This is an insulting remark to people who class themselves as sea people and the hunters of marine animals.

The Hunt

When hunters reach the area in which they wish to hunt, they scan the water for dugong and sea-

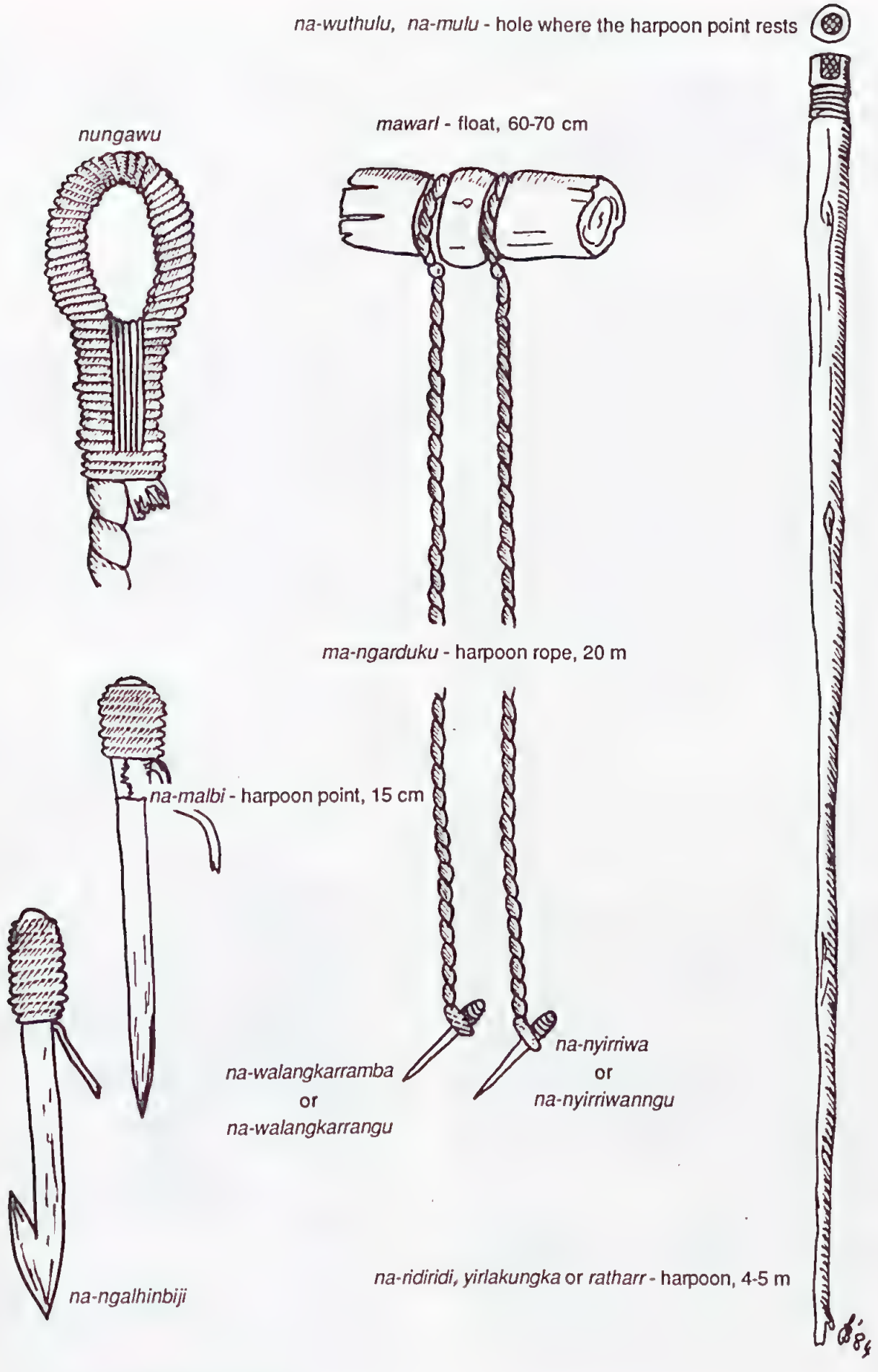

FIGURE 2. Harpooning equipment.

turtle surfacing to breathe, for muddy water which has been caused by these animals feeding, or for broken pieces of floating sea-grass and excreta. It is these signs which make visible and meaningful tracks to the hunter.

When an animal is located, the skill of the boat's 'driver' (*wuliyi/wungkayi*) is crucial. He has to follow hand signals given by the harpooner and manoeuvre him within range to spear the animal. This is often difficult as he must keep pace with the dugong which can swim at speeds of 10–12 knots for short periods. Sea-turtles are also capable of short bursts of speed and have the added advantage of keen eyesight, referred to in at least one Yanyuwa song cycle (see below). In shallow water the dugong can be tracked by the wake which is caused by the upward and downward movement of the tail, producing a series of flat circles on the surface of the water (Marsh *et al.* 1981). Sea-turtles are always tracked through the water by sight.

When a dugong has been speared once it usually tires quickly; it is then brought into range once more and speared again. The hunter usually tries to place one harpoon in the region of the neck and another in the lower back or tail region. After the animal has been speared twice the dugong is pulled alongside the boat. In Yanyuwa this action is called *lhungkayarra.* The dugong is then grabbed by the tail and a noose is placed around it, just below the flukes. The animal is turned around so its stomach is facing outwards. Its tail is braced against the gunwhale, forcing the head under water and drowning it.

In past times when the Yanyuwa hunted dugong from bark canoes the dugong was not drowned alongside the canoe for fear that the struggling animal would damage the frail craft. Instead the dugong was brought within a short distance of the canoe and then the hunter swam out to the dugong and plugged the dugong's nostrils with paperbark or even his own fingers, and he stayed with the dugong until it drowned.

From the moment a dugong is speared until it is drowned no talking takes place. It is believed that talking while the dugong is dying is a sign of great disrespect, and if someone does talk while the dugong is being pulled alongside the boat, the spirits who guard the dugong will come and remove the harpoon points.

The hunters usually try to spear young male dugongs and occasionally a cow as long as it has not got a calf or does not appear to be pregnant. The Yanyuwa dugong hunters say that they can tell the difference between a male dugong and a pregnant cow by the way in which it dives after surfacing; a pregnant cow is said to dive quicker and at a sharper angle. Large old bull dugongs are avoided because they are said to be the offspring of the Rainbow Serpent and are therefore to be feared. They can be killed but only with the assistance of special 'power songs' (*nyiri*) which are said to weaken the animal and break its back. One power song which is used in an attempt to weaken such animals is as follows:

> Miriyayurr, miriyayurr.
> Kunjurr, kunjurr.
>
> You with the spirit of the
> Rainbow Serpent,
> Your back is broken,
> truly it is cracked.
> (Isaac Walayungkuma 1985 pers. comm.).

It is said that such a dugong, if not controlled, will tow the boat to the mouth of its father, the Rainbow Serpent (*Bujimala*) and dive into the mouth, taking boat and crew with it. Quite often though, if one of these dugongs is harpooned the rope is just cut. These large dugongs are powerful, and trying to kill one by drowning would be much more hazardous.

When the dugong is drowned it is tied alongside the boat. A rope is tied around the tail which is then fixed to the back of the boat, and a harpoon point is passed through the dugong's nostrils and to this a rope is attached. This rope is tied to the front of the boat. The dugong is then taken back to land for butchering.

During times when groups of Yanyuwa people are camped on the islands they will often hunt the dugong at night. The dugong is located by listening for the sounds of dugong surfacing to breath. The dugong are followed through the water by their phosphorescent wake, called *balirrka.* As this method of hunting is considerably more dangerous there is very careful preparation of the hunting equipment before setting out.

Sea-turtle are hunted in a similar fashion to dugong. Sea-turtle can at times prove more difficult though, due to the animals' keen eyesight and the length of time which they can stay submerged. The harpooned sea-turtle will often swim under the boat, making it harder for the driver of the boat to place the harpooner in an ideal position to harpoon it for the second time. When the sea-turtle has been harpooned twice it is pulled up alongside the boat and taken hold of by its front flippers. If the sea-turtle is relatively small it is pulled directly into the boat; if it is very large and heavy it is tied to the side of the boat by the front flippers so that it hangs vertically in the water with its head above the water line. This is to ensure that the sea-turtle does not drown. The Yanyuwa believe that if they let a sea-turtle drown they will have great difficulty in finding and catching them when they go hunting again. With the sea-turtle secured either in or alongside the boat it is taken back to land for killing, cooking and butchering.

Butchering And Cooking Dugong And Sea-Turtle

Figures 3 and 4 illustrate the method by which a sea-turtle is killed and gutted. The sea-turtle is cooked whole, in its shell, before it is butchered. Firstly it is laid in a shallow pit which contains hot coals; the sea-turtle is then covered with wood which is set alight. It is then left for two to three hours. As the sea-turtle cooks it is watched to make sure that the fire does not burn through the shell, causing the *mathulmathul* to be lost. *Mathulmathul* is a rich 'soup' composed of meat and fat particles, juices, and blood. This is much sought after by older people who believe that it has medicinal value (younger people used to European food find it too rich and complain that it gives them diarrhoea). After the turtle has cooled it is butchered. Figures 5, 6, and 7 show the order in which this is done. After the first cooking much of the sea-turtle meat is still somewhat raw, so after butchering the meat is placed into a ground oven on a bed of *Acacia* leaves to complete the cooking process.

When a dugong is brought back to the land for butchering its head must be faced back in the direction of the sea. This is to enable the spirit of the dugong to return to the sea. This is an act of great importance to the Yanyuwa people and is called *ki-maramanngku,* which can be literally translated as 'returning the one belonging to the sea-grass'.

FIGURE 3. The turtle is killed by hitting it hard on the head with a stone or an axe to break the hard protective covering plates. A long sharp stick is then thrust into this hole to 'mangle the brains'. This act must be performed by a person who stands in the position of a ritual guardian of the sea-turtle.

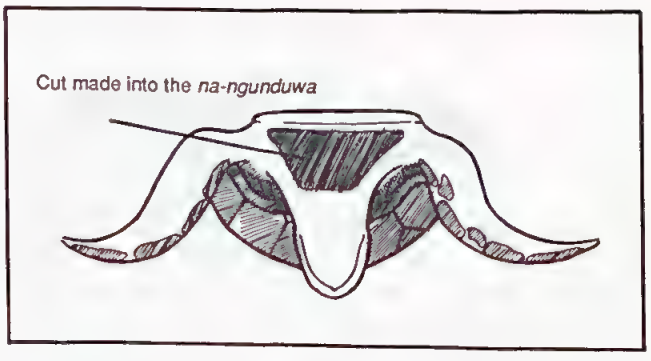

FIGURE 4. Butchering the turtle. When dead the turtle must be laid on its back, then the first cut is made. The act of making this cut is *ngunduwamantharra.* The person butchering the turtle then reaches in through this cut and removes a number of organs, listed in their order of removal: 1. *ngundurrngundurr* – section of the bronchial tube; 2. *na-widiri* – liver (eaten); 3. *rra-ngawu* – bladder; 4. *ma-mulka* – stomach (eaten; occasionally severe ulcerations are found in the stomach of old turtles, and they are called *wunakathangu*); 5. *wunakaka* – large intestines (eaten); 6. *ma-karriyalu* – small intestine (eaten). After the turtle has been gutted, paperbark is folded into small rolls and pushed into the bronchi remaining inside the turtle. The reason given for this practice is so that the turtle in the sea will not become *ngarrangarra* or without fat. The heart of the turtle is removed with the bronchial tubes and is also called *ngundurrngundurr.* The liver is also called *na-manyi,* and the stomach is also called *yalajala.*

There are two methods which can be used to butcher a dugong (see Figs 8, 9, 10). One method, called *yingkurra,* involves removing the meat in slabs with the hide still attached. This method is used when large groups of people are present and the meat can be distributed quickly. The most favoured method however is called *munbul* and involves removing the hide of the dugong in its entirety, excepting the head and tail portions. *Munbul* is considered to be the most archaic form of butchering and is therefore associated with the activities of the old people, *li-wankala,* who in contemporary times are spoken of with much emotion:

> Today that dugong was butchered in the way of my forefathers, we cut it *munbul* it really made me remember the old people, when a dugong is cut up like that and cooked, the meat is sweet. That other way, that *yingkurra* that is only new way I don't like it, it make a dugong like a bullock and that is badness. (Ida Ninganga 1986 pers. comm., translated by author).

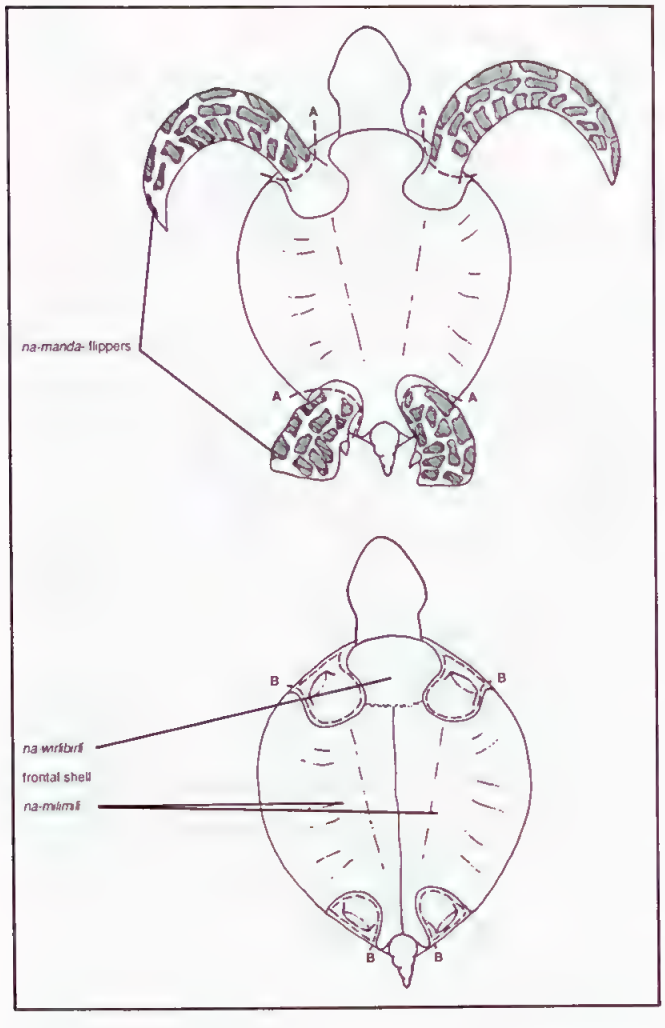

FIGURE 5. Butchering the turtle, continued. Broken lines indicate knife cuts. A. Flippers are cut off at the joint, *na-wi. B. Na-ngabala* — skin, meat and fat.

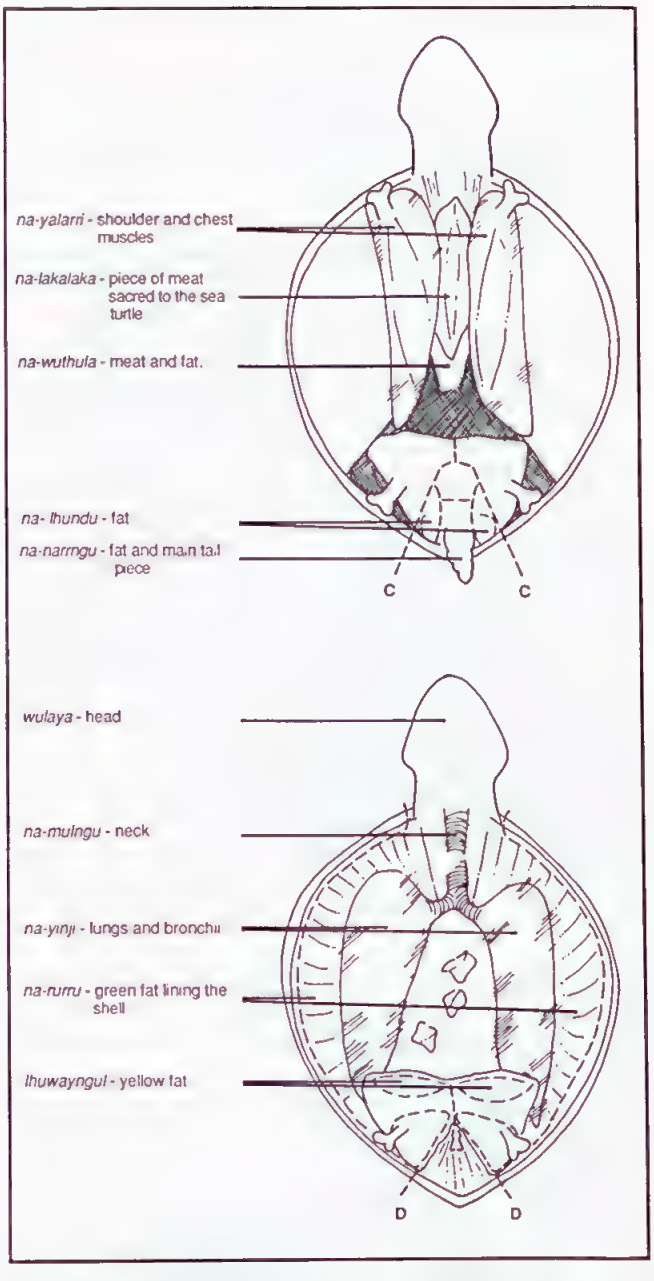
na-yalarri - shoulder and chest muscles
na-lakalaka - piece of meat sacred to the sea turtle
na-wuthula - meat and fat.
na- lhundu - fat
na-narrngu - fat and main tail piece
C
C
wulaya - head
na-mulngu - neck
na-yinji - lungs and bronchii
na-rurru - green fat lining the shell
lhuwayngul - yellow fat
D
D

FIGURE 6. Butchering the turtle, continued. Broken lines indicate knife cuts. *C. Wurrunthulburrunthul* — tail piece, fat and meat. D. *Wundumutha* – green fat and meat.

The only organ of the dugong which is eaten is the small intestine (*murajuju*). It is cut into short lengths of about 20 cm. The *murajuju* is then washed in salt water and boiled or cooked in a ground oven (*rabarr*), in similar fashion to the rest of the meat.

The oven (approximately 1 m deep, 1–2 m in width and 2 m in length) is filled with wood which is set alight. While the wood is still burning, stones are thrown into the fire to get hot. When the wood has burnt down to hot coals the heated stones are removed and green mangrove branches are laid onto the bed of coals. The meat is then placed in the oven. The head is placed at one end of the oven and the tail at the other. The smaller portions of meat are then placed between them. Onto this meat are placed hot stones, and over these cuts of meat and hot stones are placed the two halves of the rib cage which is also covered by stones. The oven is then covered with paperbark and sealed with earth. The meat is left to cook for several hours.

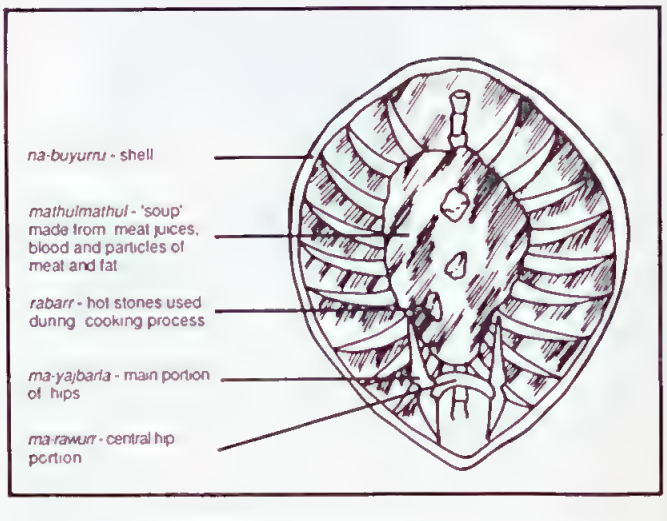
na-buyurru - shell
mathulmathul - 'soup' made from meat juices, blood and particles of meat and fat
rabarr - hot stones used during cooking process
ma-yajbarla - main portion of hips
ma-rawurr - central hip portion

FIGURE 7. Cooking the turtle.

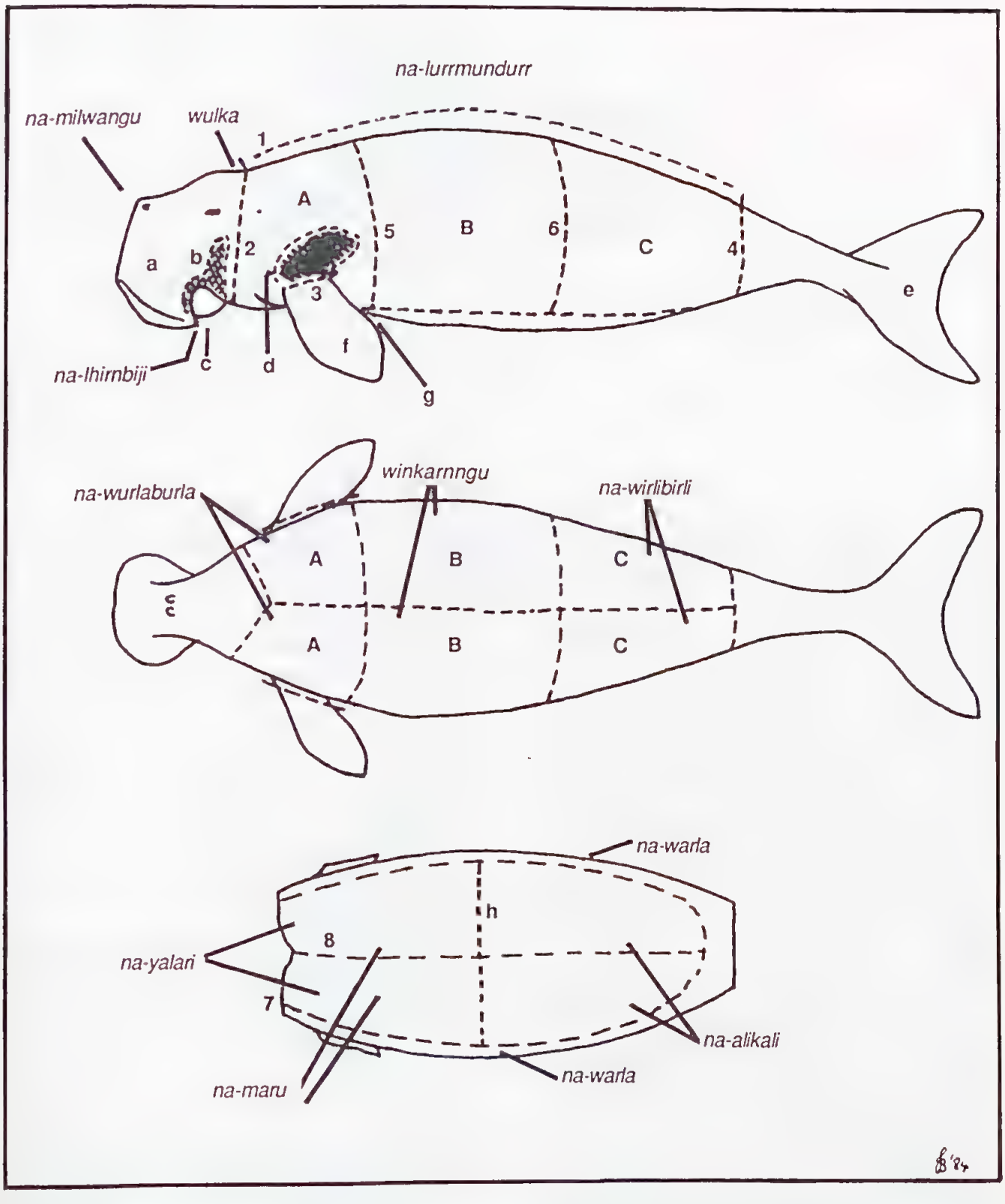

FIGURE 8. Method of butchering dugong known as *yingkurra.* Numbers refer to the order in which the cuts are made. a. *Wulaya* - head. b. *Na-rawulurr* - jaw. c. *Na-jamuka* - chin. d. *Na-yabirli* - shoulder blade. e. *Na-yirrimbi* - tail. f. *Na-manda* - flipper. g. *Na-waji* - armpit. h. *Na-wurdu* - belly section. The slabs of meat A, B, and C are called *wungal.* The hide of the dugong is called *yanjurr.* The belly section is cut in half and the two sections are called *na-yalari.*

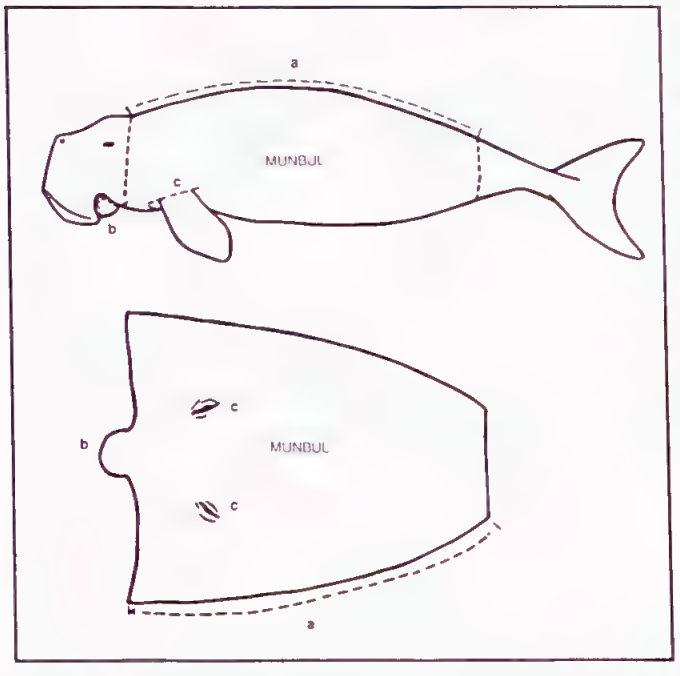

FIGURE 9. Method of butchering dugong known as *munbul*. The hide is removed in one piece and is then roasted flesh-side down on a bed of hot coals.

During certain ritual occasions parts of the dugong and sea-turtle are kept exclusively for the senior men. It is the rib-cage sections, head, and flippers which are considered sacred, and the hip and back flipper section of the sea-turtle. These are the sections which are placed into the ground oven within the confines of a restricted sacred area called *na-manda*. This area is enclosed by a semi-circular earth mound which is built to surround the ground oven. After meat cooked in the *na-manda* has been eaten all the scraps and bones are thrown back into the ground oven and burnt. The belief is that failure to dispose of the bones correctly will result in a cessation of successful hunting.

When the head of a dugong is removed from the ground oven the flesh is removed, and the jaw is separated from the skull. The jaw, skull and flesh is cooked once more. The skull of a dugong is usually thrown back into the sea or river. This is why few dugong skulls are ever found at camp sites; the head of a human or animal is deemed sacred by the Yanyuwa.

If a female dugong is killed and found to be pregnant the foetus is taken with the rest of the meat and cooked. It can only be eaten by senior men who have the dugong as their Dreaming, or by those who by Dreaming relationship call the dugong 'mother'.

The act of distributing the meat from the dugong and sea-turtle is called *wangkamantharra* and is governed by Yanyuwa law. The portion received by each person is usually based on the relationship of the people to the hunters and at times by people's Dreaming relationship to these creatures. It is not viewed favourably if the hunter does not distribute the meat. In the past such an action was enough to incite heated argument and even physical violence and this can still be the case today.

In the division of dugong meat the hunter receives some of the belly meat, the head, and if the dugong has no ritual use (in terms of *na-manda* cooking) he takes a small portion of the rib-bones and some of the intestines. The driver of the boat receives the tail, some shoulder meat and rib-bones.

If a woman's brother or sons participated in the hunt, she may not eat from the back-bone or ribs, so she is given a large portion of the intestines. The hunters' sisters, sons and daughters are not allowed to eat any of the tail portions. The hunter also makes a presentation of meat to his mother-in-law. This is done through a second person because of the strong avoidance taboo which exists between son-in-law and mother-in-law. This presentation is seen as an on-going payment in return for the man being given his wife.

The driver of a boat in a sea-turtle hunt receives some meat and associated green and yellow fat from the hip section of the turtle. He also receives some of the chest meat, intestines and green fat which lines the shell. The head and neck of the sea-turtle goes to the senior ritual guardian for the animal. The hunters' mothers and sisters are not allowed to eat the intestines of the turtle so the stomach is saved exclusively for them. As with the dugong the best meat is given to the mother-in-law of the hunter. The oil (*na-ngililî*) which the Yanyuwa obtain from the hide and meat of the dugong during the cooking process is said to have medicinal qualities and is rubbed onto the body and hair. The Yanyuwa say that it makes their hair grow strong and when rubbed on their bodies it keeps their bodies warm and free from pain.

With the advent of refrigerated storage some Yanyuwa families have the facility to store large amounts of dugong meat over a longer period. This has led to some apparent abuse of the complex rules regarding distribution of the meat, a development which is particularly resented by some older people:

> Freezer, freezer, they freeze him [dugong meat] all lot. That's *narnu-wadi* [badness], not like old people, everybody got something, selfish bugger people this day, no idea, *karawathawathamu* [swear-word]. I don't like it, that *walya* [dugong and sea-turtle] got law for everybody. (Ida Ninganga pers. comm. 1987).

Many of these problems stem from the fact that some younger Yanyuwa people have not learned the full scope of the law associated with dugong, and can thus easily offend older people:

> You know what, he brought up head [dugong head] for me, that's not the way, no idea, true, old people, my father never bin like that, I can't take head, never even been cooked, *yakayaka* [insane] true, I bin chuck that head to the dog, I never touch it, no Law, not allow . . . (Annie Karrakayn pers. comm. 1986).

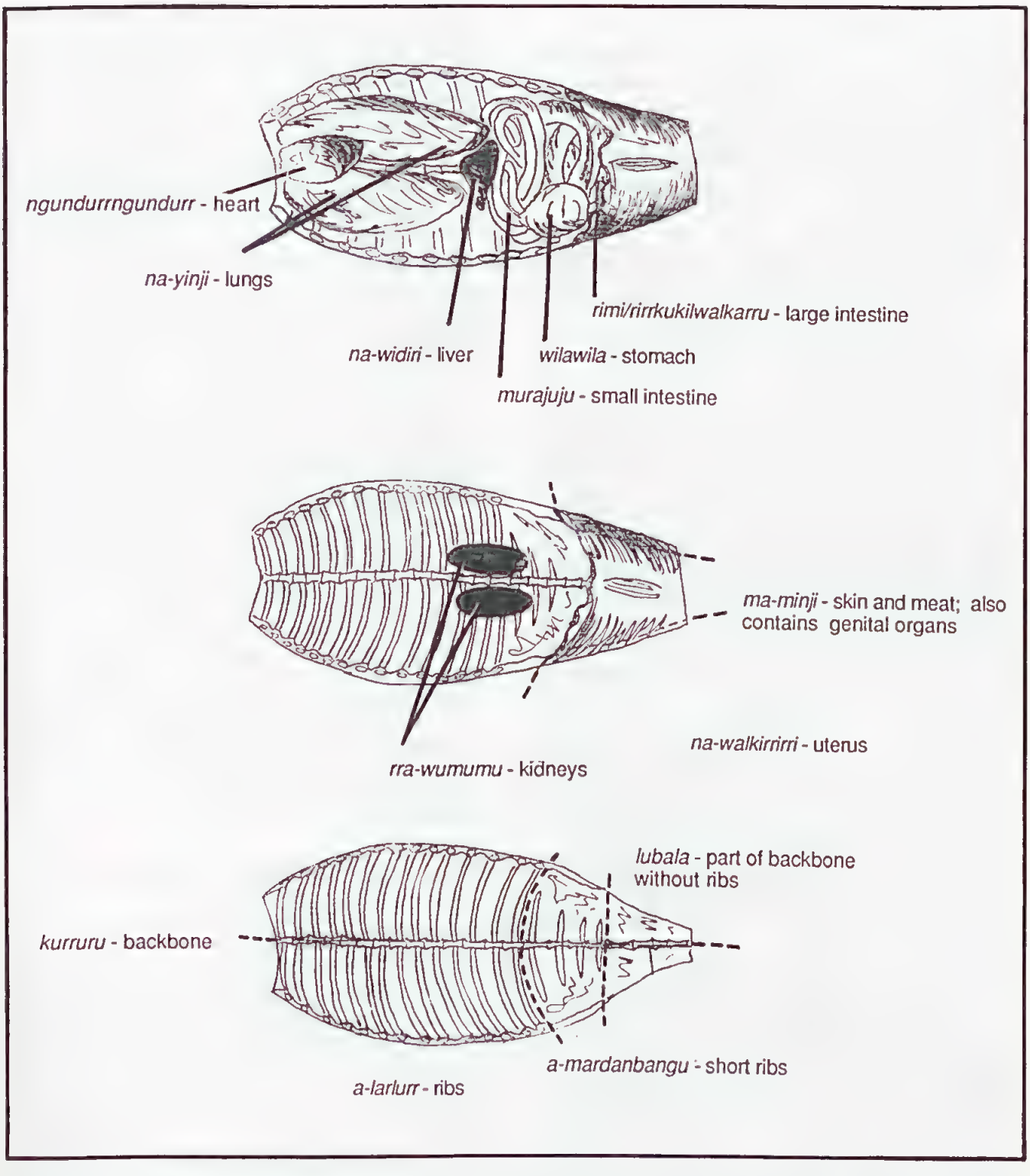
ngundurrngundurr - heart
na-yinji - lungs
rimi/rirrkukilwalkarru - large intestine
na-widiri - liver
wilawila - stomach
murajuju - small intestine
ma-minji - skin and meat; also contains genital organs
na-walkirrirri - uterus
rra-wumumu - kidneys
lubala - part of backbone without ribs
kurruru - backbone
a-mardanbangu - short ribs
a-larlurr - ribs

FIGURE 10. Gutting the dugong. Before the internal organs can be seen a layer of white fat called *rra-mayngul* is removed. Broken lines indicate knife cuts.

European Accounts

Within their oral tradition the Yanyuwa have detailed accounts dealing with the activities of dugong and sea-turtle hunting, which are both mythologically and historically based. Other sources also exist which mention Yanyuwa associations with such activities. In 1814 Matthew Flinders made the following comment:

> Turtle tracks were observed on most of the beaches, but more especially on the smaller islands, where remains of turtle feasts were generally found. (Flinders 1814: 171).

W. G. Stretton, Special Magistrate at Borroloola, commented in 1893 that

> . . . they [the Yanyuwa] are also very clever at making rope, which they use for dugong fishing. The rope is made from the bark of the Currajong tree, a species of *Brachychiton,* which these natives call 'Myaddo' [*ma-yatha*]. (Stretton 1893: 249).

One of the most detailed accounts by Europeans of a Yanyuwa dugong hunt and subsequent procedures comes from a description by W. E. Harney who spent some time with the Yanyuwa in the Sir Edward Pellew Group during the 1920s. In this book 'North of 23 Degrees' he gives this description of a dugong hunt:

> This place is the home of the dugong, which is a large sea mammal that feeds on the grass growing upon the floor of the shallow banks in this locality . . . Often I went out with them to hunt the dugong. Night was the best time, for then their path could easily be followed by the phosphorescent wake they left behind. A native would stand up in the stem of the craft, a wooden canoe, and direct the paddling native with the point of his harpoon. The canoe would glide noiselessly over the water, the men at the paddles feathering their paddles to eliminate the splash. Up would come the huge sea cow to fill its lungs with air; then bang! in would go the six-inch nail with a long rope attached to the head. The native who struck with the spear would fall overboard with it to give leverage; then quickly he would leap aboard the craft as the already wet rope went whizzing out as the dugong gathered away. The paddlers would now frantically paddle the canoe to reach a good speed when the line's end was reached; this would stop any jar which might pull out the nail. After a time the animal would tire and come to the surface for air, when another nail would be driven in to its neck or head; then down the line the hunter would go to plug up the valve with a piece of paper-bark or grass.
>
> The creature would soon die from want of air and rise slowly to the surface, to be lashed to the side, or maybe the canoe would be sunk and the animal floated in. Treading water the natives would hold the side of the canoe a little way out of the water to enable others to bail out the water. This done, they would all scramble in again and hoist sail for home. A signal would be given – a wave of the paddle or a loud blast on the conch shell, and quickly the camp would astir, as the women and children went to the bush to gather wood for the fire to roast the beef. Many were the orders given as the carcase was rolled up the sandy beach to the large fire blazing merrily away. Glass flakes, flints, and knives of the white man were all used for the cutting up. The great slabs of beef were sliced off and placed on bushes, or failing these on the sandy ground. Women would scold the eager children trying to scrape out coals to cook a little bit of meat given to them by an elder . . . The oven being now ready to take the meat, on layers of dampened bushes over hot stones are laid the first slices, then more stones and beef . . . till the whole dugong is in the oven. The latter is covered over first with paper-bark, then with sand or soil to make it airtight.
>
> Now for the waiting period. For about four hours the meat would be left there to 'stew' in its own juices; then came the sacred moment as old Friday uncovered the feast. Four to five hundredweight of . . . meat . . . As the native law of distribution now comes into force, Friday the uncle or mother's brother of the chap who caught the dugong will hand the portions out. A lovely hindquarter to the hunter's mother's mother, or Ku Ku [*sic*]; a forequarter to his mother's brother; a belly piece to this person; the head to the hunter, as well as the tail. Each receives his share, according to a just law, so that no rows may arise over the giving out of food. One group of people receives nothing; these are the women with their menses. To them it is forbidden, or taboo; they call the word 'gooda gooda' [*sic*]. Should they eat of this meat, then the dugongs would be offended and leave that locality, which, when one comes to think of it, provides a clever excuse should the hunter return without a kill. (Harney 1946: 161–163).

Mythology And Ritual Associated With Dugong And Sea-Turtle

Both the dugong and sea-turtle are important mythological beings for the Yanyuwa and neighbouring groups to the north. The Mara people whose country lies to the north-west of the Yanyuwa have a very important Dugong Dreaming centre. This site, known as Wunubarryi (Mt Young), lies some seven kilometres south-east from the mouth of the Limmen River. The Yanyuwa people also recognise the importance of this site and they share in the control and use of the Dugong Dreaming power which is centred there.

Just to the east of Wunubarryi are a number of quartzite outcrops. These are believed by the Mara and Yanyuwa to be metamorphosed dugong and a single dolphin which were stranded on dry land by a receding king tide (*bambiliwa*) during the Dreaming. It is interesting to note that a similar occurrence happened in 1984 during Cyclone Kathy; a number of dugong and sea-turtle were stranded after a storm surge carried them up to eight kilometres inland in the vicinity of the McArthur River delta area.

The Dugong Dreaming represents a herd of dugong (see Fig. 11). Two of the rocks are males, while the others are females. It is at one of these female dugong that the Yanyuwa and Mara custodians for this site carry out dugong increase rituals. When men wish to perform these rituals they approach the Dugong Dreaming herd and brush down the 'female dugong' they have selected for use in the ritual. Surrounding the 'female dugong' are a number of hammerstones. One of these hammerstones is taken and the 'female dugong' is struck while the names of dugong hunting localities along the coast and in the area of the Pellew Islands are called out. A translated example of this recitation is as follows (see Fig. 1 for localities):

> You dugong, listen to me, you will come out from here and you will travel to Wuthanda (McArthur River mouth), Liwujujuluwa (Crooked River mouth), Lidambuwa (Sharkers Point) and Bulubuluwiji (Wearyan River mouth). Listen to these words that I am telling you! (Tommy Rilley (Nawurrungu) 1983 pers. comm.)

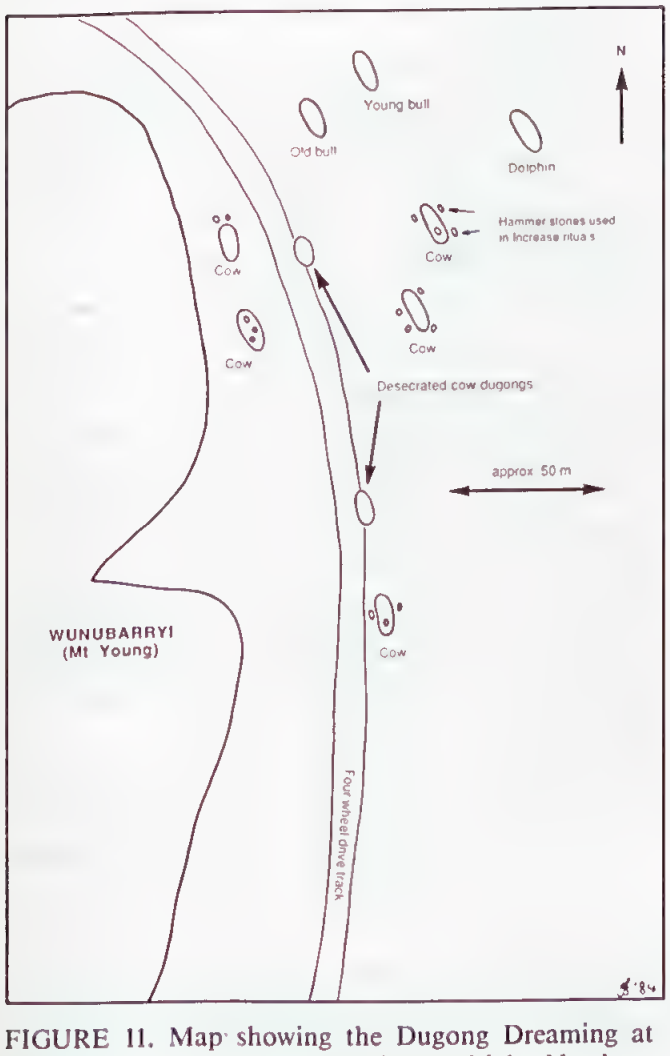

FIGURE 11. Map showing the Dugong Dreaming at Wunubarryi (Mt Young) in the Limmen Bight, Northern Territory.

Some of the 'female dugong' have deep grooves and depressions in them indicating that the rites of increase are of some antiquity.

In 1976 this Dugong Dreaming site at Wunubarryi was desecrated. The owners of the Nathan River Station, where Wunubarryi is located, dug out two of the 'female dugongs' while constructing a four wheel drive track through the area. The Yanyuwa and Mara people were extremely upset over this incident and consider that the dugong population in the area of the Sir Edward Pellew Group has suffered because of this desecration.

The Yanyuwa people have a Dreaming site for the Lone Male Dugong (*jiyamirama*) at Wungunda on the southern bank of the mouth of the Crooked River, and at Wirdiwirdila, a small island in the Wearyan River is a Dreaming site associated with the rib-bones of the Lone Male Dugong. During the singing of their ceremonial song cycles the Yanyuwa also sing of the dugong, and some of these verses are given below. These particular verses, belonging to the Yanyuwa Rrumburriya semi-moiety, are associated with the dugong hunting locality of Bulubuluwiji at the mouth of the Wearyan River:

> Wabarrkuramba
> jirrimbi ramba
>
> The tail of the dugong
> strikes the water
>
> Yarakiyara
> lhungkarrmi
> lhungka
>
> The cows are gathering,
> they travel with their calves
>
> Narnawirijarra
> yumbarrimajarra
>
> The bull dugong thrashes,
> it tires (It has been harpooned).
> (Old Tim Rakawurlma 1982 pers. comm.).

The song of the Lone Male Dugong is sung in the song cycle of the Yanyuwa *Wuyaliya* semi-moiety:

> Jiyamirama
> wukuwarrima
>
> The back of the Lone Male Dugong,
> is clearly showing.
> (Old Tim Rakawurlma 1982 pers. comm.).

The sea-turtle is associated mythologically with a number of areas over the Sir Edward Pellew Group. The west coast of West Island and the coastal margins of Bing Bong Station are associated with the Dreaming path of the Green Turtle. This sea-turtle completed its travels on a reef called Liwintha, which lies just to the south of West Island. Watson Island and the northern section of

North Island are also associated with the path of the Green Turtle Dreaming. Various rock formations along the Dreaming path of this turtle represent the shell, internal organs and segments of meat which the hunters of sea-turtle find important. One song cycle verse associated with the green turtle is as follows:

> Biyalawuna
> Yurrunjurr na-mi.
>
> The Green Turtle with round wide eyes
> like the uppermost grindstone,
> It sees a great distance.
> (Old Tim Rakawurlma 1982 pers. comm.).

Yanyuwa Views Of Dugong And Sea-Turtle Exploitation Sites

Evidence of the Yanyuwa's utilisation of dugong and sea-turtle as a food source can be found on many sites in the Sir Edward Pellew Group. Some of these sites are apparently quite old, while others were used within the last thirty years. No matter what the age of the site they share in common such things as charcoal, stones which show evidence of having been affected by heat, and scatterings of bone and skeletal remains which may give evidence of the numbers of people at these sites and from where the meat source was obtained. Minnegal (1984b) identifies four types of dugong butchering sites in Queensland's Princess Charlotte Bay region. Three of these sites have direct relevance to the Yanyuwa:

1. Initial butchering sites – where dugong were removed from the water and cut into a number of large segments to facilitate transport back to camp.
2. Primary, and primarily, dugong consumption sites – where large parcels of dugong meat were taken to be further butchered, cooked and consumed.
3. Base camps – where individuals took any remnants of dugong meat left over from the initial feasts.

(Minnegal 1984b: 15)

Figures 12, 13, 14 and 15 illustrate the factors which Minnegal (1984a and b) discusses. All of these sites, with the exception of that in Fig. 13, are still used by the Yanyuwa as base camps for the exploitation of dugong and sea-turtle and for the cooking and distribution of the meat. Each diagram is accompanied by a description of the site elements and a description of the site given by Yanyuwa people.

The Yungkurra site (Fig. 12) is still a favoured butchering site due to its close proximity to major sea-grass beds in the region of the McArthur River delta region. A unique feature of the site is a cleared 'causeway' some six metres in length. This feature seems to be of great age and was possibly constructed by clearing a pathway through the mangroves of the intertidal zone and then clearing this area down to the bedrock by removing the loose stones and rocks. The end result is an obvious cleared pathway which makes the task of rolling dead dugong, and pulling sea-turtles, ashore to a butchering point much easier. The cleared area would also have made the beaching of canoes an easier task where the rocky nature of the area makes safe mooring difficult. It also provides ease of access to the sea for people when washing the offal removed from the creatures prior to cooking. The foredune area at the end of the causeway is littered with bone fragments of turtle and dugong as well as the stones and charcoal from the ground ovens used during the cooking process. This site is still used for beaching and butchering dugong and sea-turtle. No cooking has taken place at the site in recent times though, as dugong meat or live sea-turtles are loaded directly into the boats and taken to base camps on other parts of the islands or further up the McArthur River. A senior custodian for the Yungkurra site, Tim Rakawurlma made the following comments:

> The old people long before me they threw stones to the north and south, and in doing so they made a road. The road is for dugong and turtle and maybe canoes when there was wind and waves. I cut dugong up at that place as did my father and my sons, they still use that place. Perhaps they were really clever those old people, would you think that?
> (Tim Rakawurlma 1985 pers. comm., translated by the author).

The site of Rumannguwa (Fig. 13) is located on a hill on North Island, about one kilometre from the coast. It is some distance from any of the major areas where dugong and sea-turtle are found. The site consists of a permanent fresh-water lagoon, the north-western corner of which has a large and relatively bare sand-ridge upon which evidence of past occupation can be found. On the north-eastern end of the ridge, the remains of a dugong were found after heavy rain washed the area in 1984, during Cyclone Kathy. The remains are of the head, a shoulder, and some ribs. Also in evidence are charcoal and stones used in a ground oven. Johnson Timothy, a senior custodian for the island, has reconstructed what he felt the site represented:

> This might be where my old grandfather Lithi camped, he was boss for this country. I reckon just him and his family were here; you see there is only a little bit of dugong bone here. This dugong was killed somewhere else and the meat was given to the family. Old Lithi must have got the head, shoulder and a few rib-bones. It was a long way to carry the meat but the old people used big string bags, *a-birndawarra* to carry meat in, hanging on poles or on their heads. This was

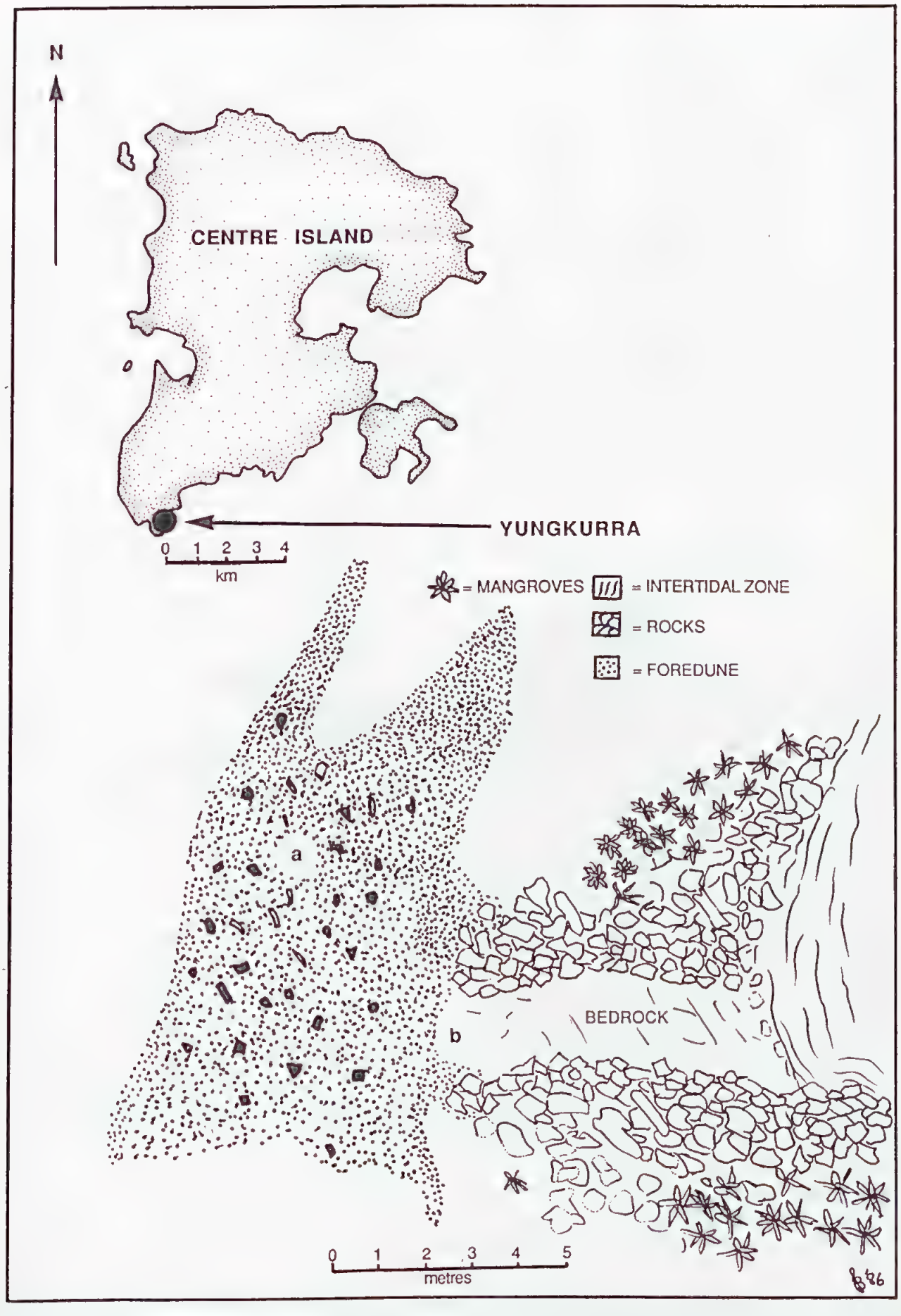

FIGURE 12. The Yungkurra site. a. Area of foredune littered with charcoal, stones used in ground ovens, and bone fragments. b. 'Causeway' – area cleared of stone to facilitate the landing and butchering of dugong and sea-turtle.

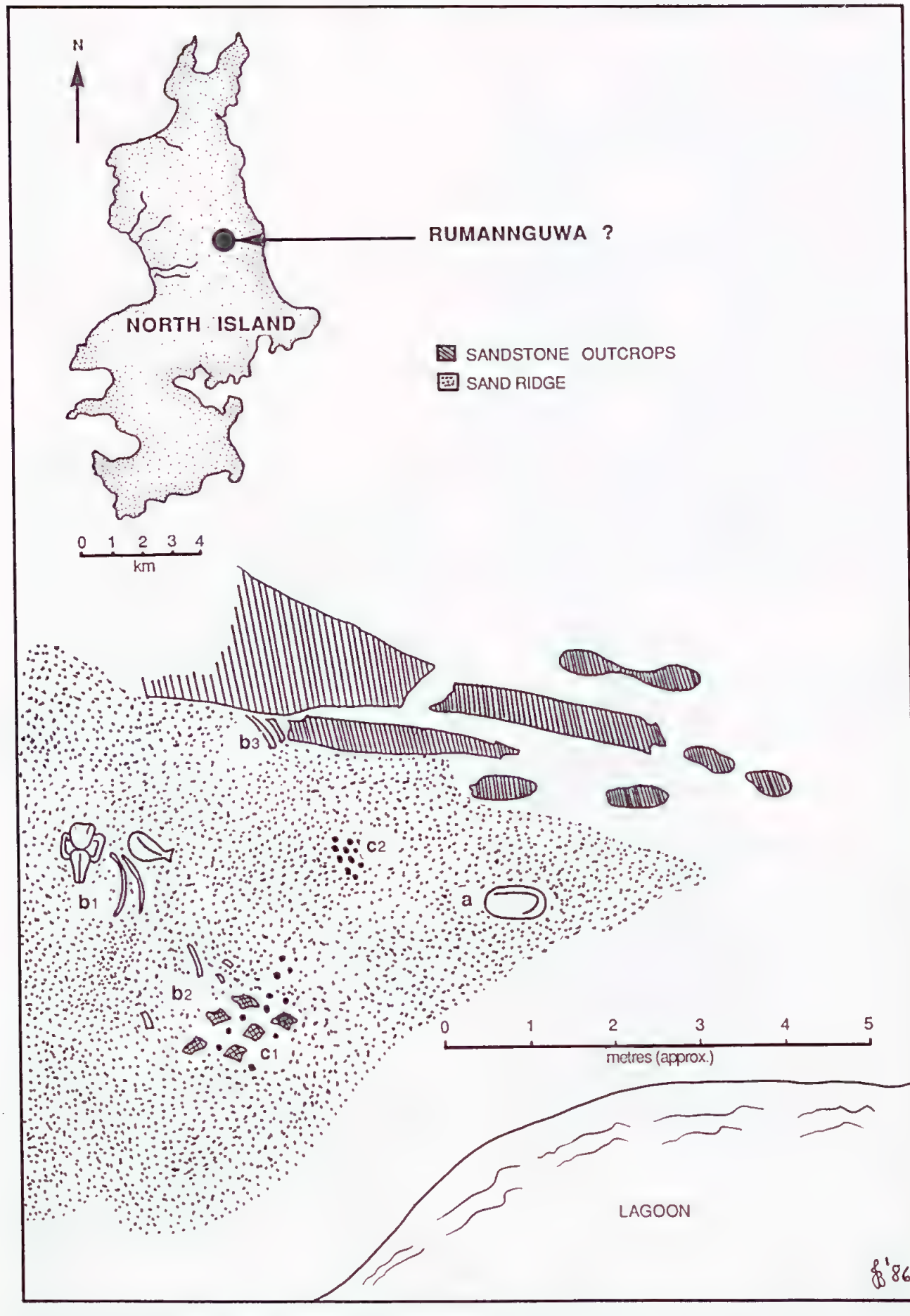

FIGURE 13. The Rumannguwa site. a: Grindstone. b^1: Dugong skull, shoulder blade, ribs. b^2: Ribs and rib fragments. b^3: Ribs. c^1: Ground oven, cooking stones and charcoal. c^2: Charcoal.

a wet season (Ihabayi) place because water would run away. This place makes me think hard for the old people. That grindstone, they must have ground up lily seed, that *ma-rnayi,* or smashed up dugong meat to make it soft for the old people or young children. See those rib bones [b3] over in that little cave maybe a dog or kid went away by himself to eat. Old people they make me think. (Johnson Timothy 1984 pers. comm., translated by author).

Much of Johnson's speculation can be supported. The site is some 33 kilometres away from the nearest areas where dugong may be found in large numbers, and it is possible that the people responsible for leaving the remains shared in a dugong capture elsewhere and then took what meat they could carry back with them. The use of large string bags for the carrying of meat is quite often mentioned by the Yanyuwa. Today the Yanyuwa use commercially made bags and plastic boxes for the same purpose. The use of a grindstone or pounding stone for pounding meat is also still practised by the Yanyuwa. This is especially true for old people with severe dental damage or young children just beginning to take solids. The pounded meat is often mixed with water to make a form of thick broth.

The site of Nganthaa (Fig. 14) is still considered to be a favoured base camp from which to hunt dugong and sea-turtle. The site is in very close proximity to the major sea-grass beds around the McArthur River delta. The site described here was recorded in 1980 but archaeological evidence of the site was destroyed during high tides caused by Cyclone Kathy. The site is still used, but it is very rare for any cooking to take place there as the meat is usually loaded in the boats and taken back to Borroloola, or other centres. The site was described by one of the senior custodians in the following way:

This camp here, these dugong bones belong to the camp of my father, really my father's brother, old Babawurda. We camped here in the cold season time. My father he harpooned the dugong and cut it up on the reef at low tide, he didn't worry about sharks.

We cooked the dugong and we stayed there for a while. Later we killed a turtle and another dugong but we took them back home to Borroloola. We used to cook that dugong meat really well. That ground oven we used the same one all the time when we camped here. Those *rabarr* [stones used in ground oven] are probably from the old people. That first tree (b2), that where old Babawurdi camped with his wife, that why he had the head and shoulder, that other tree (b3) only ribs and some *lubala* [part of backbone without ribs] that was Billy and Graham's camp [his sons], they were only young then. That other camp (b4), that was where my aunty was camping, sister for that old man, that's why no rib-bone is there and I camped at that end tree (b5) with my wife and Douglas and Thelma. I was paddler for that canoe so I got tail and ribs.

Those other ribs in the ground oven they were eaten at that place again and thrown back in the oven. (Don Miller 1980 pers. comm., translated by the author).

Another site, Walangkurra (Fig. 15), is the nearest mainland site to the sea, and more importantly it is very close to major sea-grass beds lying to the south of West Island. This site was documented one day after the people who had been camped there for a week had left to return to Borroloola. The scattered dugong bones indicate residence patterns and kinship ties and reflect the continued importance placed on the proper distribution of meat according to kinship rules.

The camp c6 at Walangkurra is of special interest, in that the person who camped there was one of the senior Jungkayi (Guardian) for the dugong and was therefore given the head of the animal by the hunter. The head is considered the most sacred part of the animal. Normally the head of the animal would be returned to the sea. The hunter's sister's camp, c1, reflects the law under which the sisters of the hunter are not permitted to eat the meat from the rib-bones or back-bone of the dugong.

Continuing Significance Of The Dugong And Sea-Turtle To The Yanyuwa

The Yanyuwa still regard the dugong and sea-turtle as vital elements in their economy, and cannot conceive of a time when they would not be able to have them as part of their diet. Within the Sir Edward Pellew Group sea-turtle remains present in large numbers, but the Yanyuwa have in recent times begun to fear for the safety of the dugong. With the increased use of the islands as a fishing and tourist destination, signs are becoming more and more evident that the dugong, and perhaps the sea-turtle population, will become more threatened as development increases. In November of 1983 while travelling to the islands via the Carrington Channel the author found two dead dugong on the mud flats at the mouth of the Carrington River. Both had been shot with high powered rifles. Another four dead dugong with gunshot wounds were found during the following days. This number of dugong represents approximately half the number the Yanyuwa men kill per year using traditional methods.

Yanyuwa men and women are continually finding more dugong which have suffered at the hands of visitors to the islands. Dead dugong have been found with their heads cut off or showing signs of being slashed with sharp objects. Other dugong are found showing severe abrasions and cuts caused by fishing nets. In April of 1984 a group of Yanyuwa men travelled to South West Island, and while there they found the dismembered carcass of a dugong. Attempts had been made to cover the butchered remains with stones. The method employed to butcher the dugong and the amount of waste meat

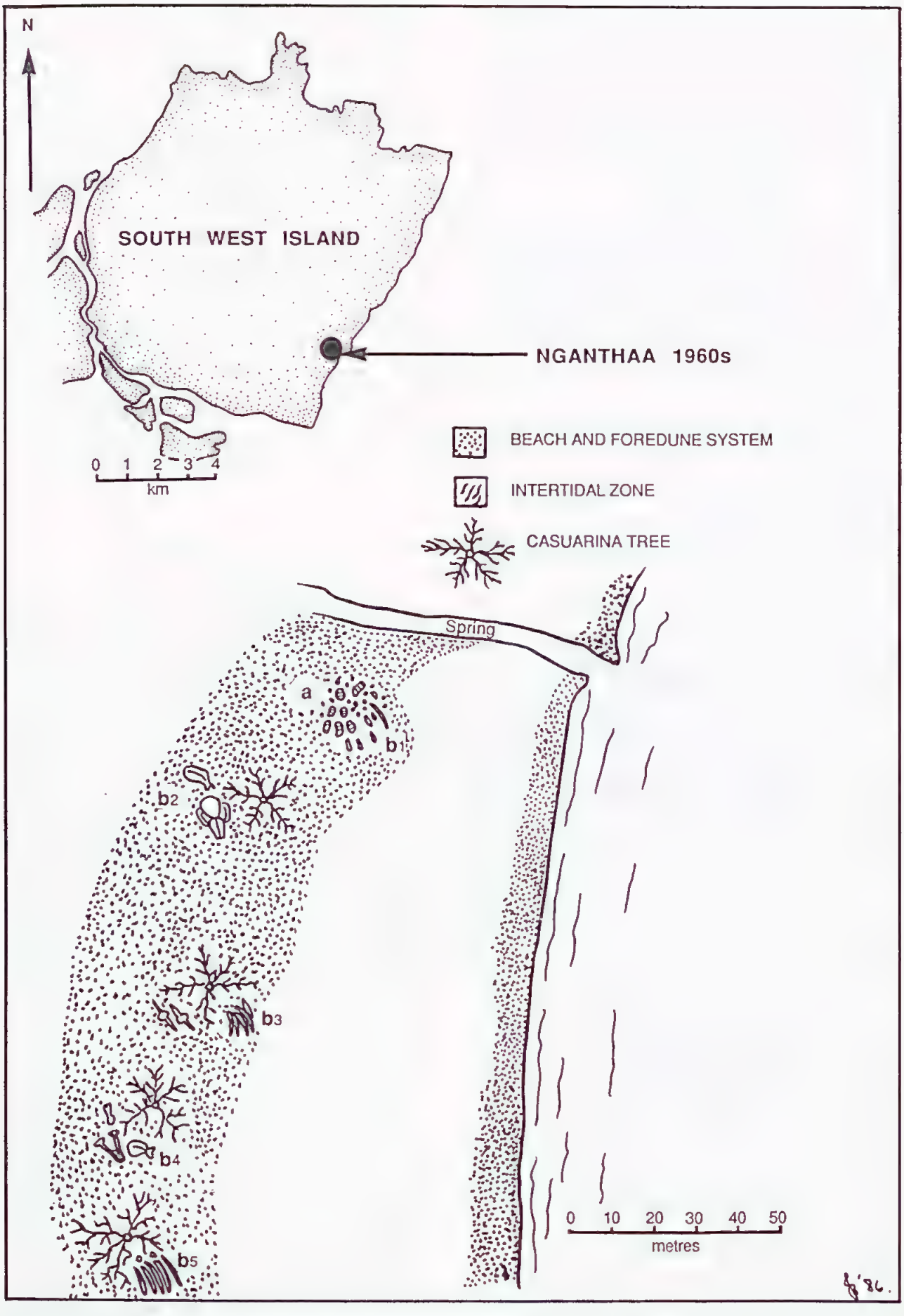

FIGURE 14. The Ngathaa site. a: Ground oven, cooking stones and charcoal. b^1: Numerous rib fragments. b^2: Skull and shoulder blade. b^3: Rib-bones, lumbar vertebrae. b^4: Jaw, shoulder blade, humerus. b^5: Rib-bones, some fragments of vertebrae.

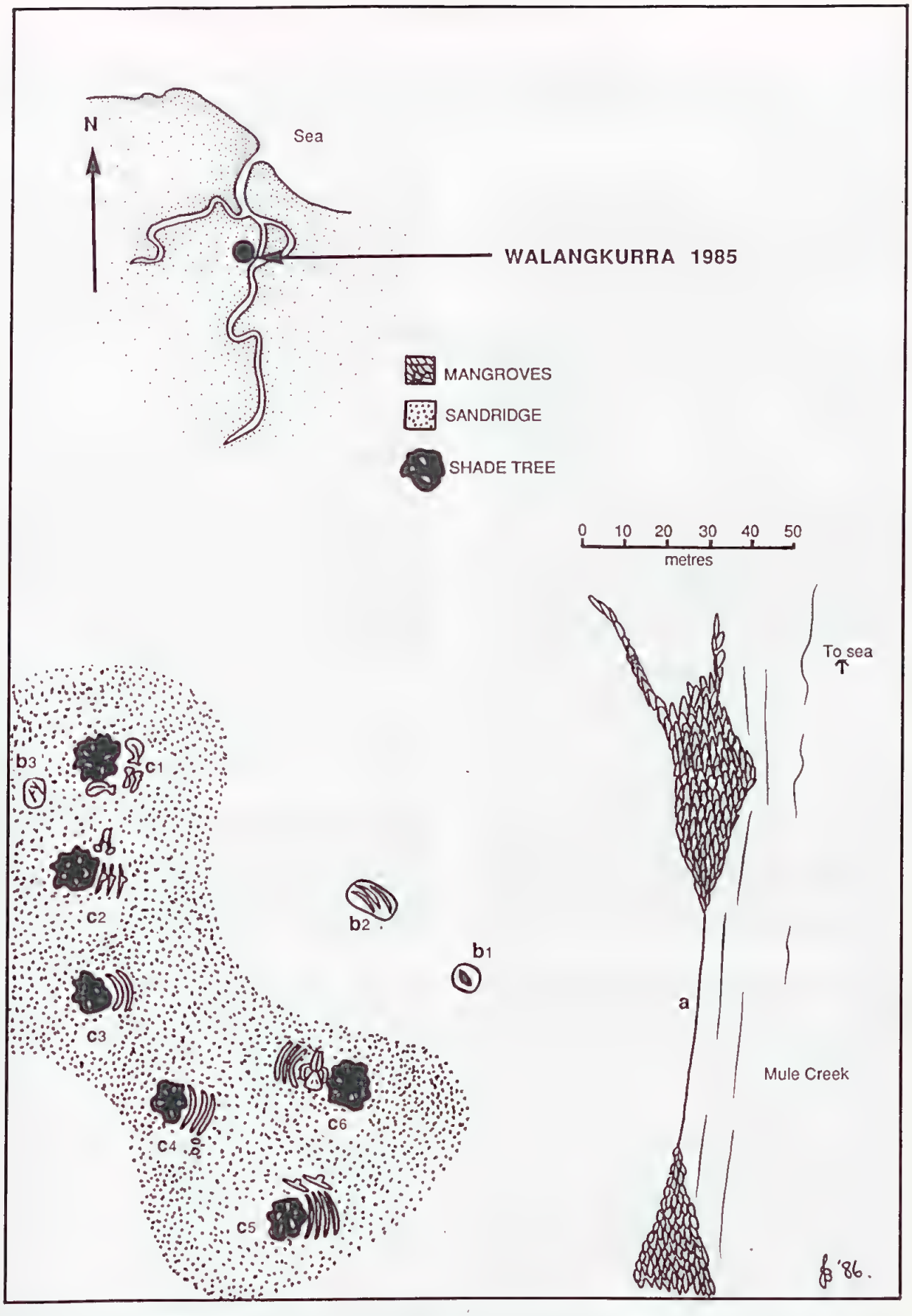

FIGURE 15. The Walangkurra site, on the Mule Creek – Bing Bong Pastoral Lease. a: Butchering area for dugong and sea-turtle. b^1: Ground oven for sea-turtle containing burnt up shell and flippers. b^2: Ground oven for dugong containing rib-bones and ground oven stones. b^3: Secondary ground oven for sea-turtle meat; also contains pelvic bones of the sea-turtle. c^1: Hunter's sister's camp; shoulder blades and humerus. c^2: Hunter's mother's camp; jaw bone and lumbar vertebrae. c^4: Boat driver's camp; rib-bones and small vertebrae from tail. c^5: Hunter's camp; rib-bones and lumbar vertebrae. c^6: Hunter's cousin's camp; *jungkayi* for dugong; head and rib-bones.

found did not correlate with the traditional methods employed by the Yanyuwa. It is reasonable to infer therefore that this dugong too was a victim of non-Aboriginal hunters.

The continuing episodes of damage to the dugong and sea-turtle population greatly concern the Yanyuwa. The dugong and sea-turtle represent Dreamings for certain individuals and groups of people. The continuing episodes of dugong slaughter, damage to important areas for sea-turtle and the desecration of important ritual centres causes unrest in terms of the functioning of a traditionally-based society. There is also concern that those people who stand in a 'mother' guardian relationship to the dugong and sea-turtle are not fulfilling their duties and obligations towards the species, an offence which is punishable under the dictates of traditional Law.

It becomes clear then, that to the Yanyuwa and Mara people the problem is not just conservation of the dugong and sea-turtle, but also the maintenance of ritual activities which reinforce the spiritual principles underlying Yanyuwa/Mara society. The Yanyuwa people are justifiably proud of their dugong and sea-turtle hunting heritage. In their oral history accounts certain men are mentioned over and over again as being 'dugong and sea-turtle hunters of excellence', *maramaranja.* Younger men will say with pride that they were 'trained' by these skillful men. Certain old men among the Yanyuwa who were skilled hunters in their youth are spoken of with high regard and their advice is still sought in terms of Law and practical knowledge concerning the dugong and sea-turtle. In a world where values are changing quickly the continuation of the hunting of these two marine animals remains one way in which the Yanyuwa people can continue to identify themselves with pride as 'salt-water people'.

Acknowledgments

The author gratefully acknowledges the help and assistance given by the following Yanyuwa men:— Don Miller, Johnson Timothy, Graham Friday, Musso Harvey, Tim Rakawurlma and Tom Friday. Assistance was also given by the following Yanyuwa women:- Jemima Miller, Dinah Norman, Ida Ninganga, Annie Karrakayn and Eileen McDinny. The author is grateful for the support given by Jean Kirton, Dr Helene Marsh, Dr Ian Poiner, Bob Ellis and the staff of the Aboriginal Sacred Sites Protection Authority who provided valuable technical assistance for the final draft of this paper.

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THE CUSTODIANSHIP OF SACRED OBJECTS PROJECT: AN OVERVIEW

For the last five years the South Australian Museum's Custodianship of Sacred Objects Project has operated in Central Australia in an attempt to inform Aboriginal people about the Museum's Restricted Collection and to discuss with them ways to deal with it.

The project, run by Christopher Anderson with the assistance of other Division of Anthropology staff especially Philip Clarke, has concentrated on the *tjurunga* and sacred boards from Central Australia. This is because these constitute almost 80% of the South Australian Museum's collection of restricted material.

There are four aspects to the project:

a) physical organisation of the collection and of its documentation; computerization of all data for immediate access;

b) planning and implementing a programme to let Aboriginal people in the relevant communities know about the collection's content and secure storage; providing details of the project for discussion regarding custodianship of the collection;

c) Narrowing the focus of discussions to particular communities and beginning the necessary background research; consulting with senior men in these communities;

d) Return of objects (if this is the outcome and if all conditions set by all parties are met); fulfilling the responsibilities and commitments that come out of the relationships created by the project (assistance with establishment of local 'keeping places', assistance with cultural activities such as joint exhibitions, and so on).

A further related aspect has been the visits to the Museum by senior Aboriginal men from Central Australia. Since 1985 we have had eleven major visits by men to view the storage arrangements for restricted objects and to discuss matters relating to them. In most cases these visits were funded from outside the project; generally, the men were already in Adelaide for other purposes. They have always been very happy with the storage and curation arrangements at the Museum.

Discussions in Adelaide and in Aboriginal communities have also been held about secret/sacred material from north-east Arnhem Land, Borroloola (Northern Territory), and Aurukun (Queensland). We have also offered advice to other communities, including Docker River, and to Eastern Aranda people in Central Australia about the location of certain secret/sacred objects which have been noted as missing from those communities.

Fieldwork

As the Curator responsible for this project, I have conducted ten field trips totalling over 160 days to the following communities:

Yuendumu and outstations (N.T.)
Yuelamu (Mt Allan) (N.T.)
Mt Liebig (N.T.)
Walungurru (Kintore) and outstations (N.T.)
Papunya (N.T.)
Fregon (S.A.)
Ernabella (S.A.)
Marree (S.A.)
Oodnadatta (S.A.)

Because of the detailed knowledge required of local community politics, I have had to rely on anthropologists who already know a given community well for background information and assistance. This has on occasion involved travel for the purposes of working with them prior to a field trip. In some cases we have funded them to come to Adelaide and also engaged them as consultants in the field. Because of the inability of one person to handle all consultations that arise from the project we are using external funding to supplement Museum resources to engage consultants to assist with at least four communities (Maryvale, Hermannsburg, Haast Bluff and Mt Liebig). Geoff Bagshaw has undertaken considerable work on the project at Haast Bluff, Kintore and elsewhere. I have also had assistance from John Kean and from staff of the Central Land Council.

Results

The South Australian Museum has returned around 130 restricted objects to Aboriginal custodians in Central Australia. Aboriginal men have thus far only been willing to discuss objects for which there is reasonably full documentation. At the very least, the 'Dreaming' or totemic affiliation and the site name are required. On this criterion only about 20% of the South Australian Museum's collection is subject to the project's consultation programme and possible transfer of custodianship. The Museum considers itself to have an important obligation to continue preserving the other material. The communities involved have supported us in this.

The future of the project

The salary of a full-time curator at a Scientific Officer Grade 3 level and office overheads have been met by the South Australian government. The redevelopment of the Restricted Collection store,

including the installation of purpose-built cabinets, was completed at a cost of $100,000 as part of the overall Anthropology store and office re-organization during 1985-86. The Anthropology Division contributes annually towards the project's running costs and towards care of the collection. Field consultation trips averaging three weeks in duration cost about $5000 each, including vehicle costs and field expenses. The Department of Aboriginal Affairs has contributed $43,507 toward the cost of the project. This has been primarily to cover consultation expenses.

Existing grant funds were exhausted at the end of 1990 and with the restructuring of Aboriginal funding through the newly established Aboriginal and Torres Strait Islander Commission (ATSIC), the project will have to be funded differently. Personnel changes within the Division of Anthropology may also affect the project.

The Custodianship Project has benefited the Museum in many ways in its dealings with Aboriginal communities. The issues go far beyond those involving secret/sacred material. The project has also attracted considerable attention from the museum and anthropology professions, and has raised the national and international profile of the South Australian Museum.

Major project publications

ANDERSON, C. 1987. Research and the return of objects as a social process. *Conference of Museum Anthropologists Bulletin* **18**: 2–8.

ANDERSON, C. 1990. Repatriation of cultural property: a social process. *Museum* **152**(1): 54–55.

ANDERSON, C. 1990. Australian Aborigines and museums – a new relationship. *Curator* **33**(3): 165–79.

ANDERSON, C. in press. The economics of sacred art: The uses of a secret collection in the South Australian Museum. *In* 'Papers presented to the Pacific Arts Association's 4th International Symposium – Arts of the Pacific'. 6–12 August 1988. Ed. P. Dark. University of Hawaii Press: Honolulu.

ANDERSON, C. in press. Repatriation, custodianship and the policies of the South Australian Museum. Paper presented to the Conference of Museum Anthropologists, 28 November – 1 December 1989, Canberra.

Christopher ANDERSON, Head, Division of Anthropology, South Australian Museum, North Terrace, Adelaide, South Australia 5000. *Rec. S. Aust. Mus.* **25**(1): 111–112, 1991.

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A NEW GENUS OF THE BRYOZOAN FAMILY ELECTRIDAE, WITH A PLECTRIFORM APPARATUS

D. P. GORDON & S. A. PARKER

GORDON, D. P. & PARKER, S. A. 1991. A new genus of the bryozoan family Electridae, with a plectriform apparatus. *Rec. S. Aust. Mus.* **25**(2): 113–120.

A new bryozoan genus, *Mychoplectra* (type species *Lepralia pocula* Hutton), is established for two southern Australian species of Electridae with a spurred, scoop-like plectriform apparatus. These species were formerly placed in *Pyripora*, which lacks such an apparatus. It is shown that *M. pocula* is not conspecific with *Cellepora alata* Lamouroux, which is a species of *Diploporella* (Thalamoporellidae). *Mychoplectra pocula* is a protogynous hermaphrodite.

D. P. Gordon, New Zealand Oceanographic Institute, Division of Water Sciences, DSIR, Private Bag, Kilbirnie, Wellington 3, New Zealand, and S. A. Parker, South Australian Museum, North Terrace, Adelaide, South Australia 5000. Manuscript received 20 August 1990.

The electrid bryozoan genus *Pyripora* d'Orbigny, 1849 is best known by the north-eastern Atlantic Recent species *P. catenularia* (Fleming). This species, like a number of related fossils including the type species *P. pyriformis* (Michelin), forms encrusting branching chains of simple pyriform zooids, each of which has a proximal gymnocyst and a coextensive membranous frontal wall with a narrow granular cryptocyst bordering the opesia. As is typical of electrids, there are no avicularia or ovicells. As Taylor (1986) has remarked, the absence of ovicells in these species suggests that the larva is of the planktotrophic cyphonautes type, though none has yet been recognized.

Three species of *Pyripora* have been reported from the southern coast of Australia: *P. polita* (Hincks, 1880), *P. crassa* (MacGillivray, 1869) and *P. catenularia* (Fleming, 1828). *Pyripora polita* (=*Lepralia pocula* Hutton, 1878, see below) is a common encruster of sea-grass stems and has been illustrated by scanning electron microscopy [Bock 1982, fig. 9.7(c)]. *P. crassa* and Australian *P. catenularia* have to date been little-known.

During an examination and subsequent taxonomic revision of F. W. Hutton's collection of South Australian bryozoans in the Otago Museum, New Zealand (Gordon & Parker 1991b), skeletal structures were discovered in '*P.*' *pocula* that clearly affected its generic placement. This finding led to an investigation of all three putative Australian species of *Pyripora*. The skeletal structures constitute the plectriform apparatus (Gordon & Parker 1991a), an internal elaboration of the gymnocyst, which occurs in several species of malacostegine bryozoans. It does not occur in the type species of *Pyripora* (*P. pyriformis*), however, and a new genus is required for the Australian species.

SYSTEMATICS

Mychoplectra gen. nov.

Diagnosis

Colony encrusting, uniserial to multiserial. Zooids generally pyriform, with extensive proximal gymnocyst and narrow granular cryptocyst. Kenozooids present. Plectriform apparatus present. Articulated spines, avicularia and ovicells absent. Embryos numerous, non-brooded. Simple uniporous septula present.

Etymology

Mychoplectra, f., formed from Gk *mychos*, inmost part, recess, and *plektron*, spur. Although *plektron* is a neuter noun, *Mychoplectra* is here introduced as feminine in gender [see the International Code of Zoological Nomenclature, Article 30(a) (iv) (Ride *et al.* 1985: 58–59)].

Type species

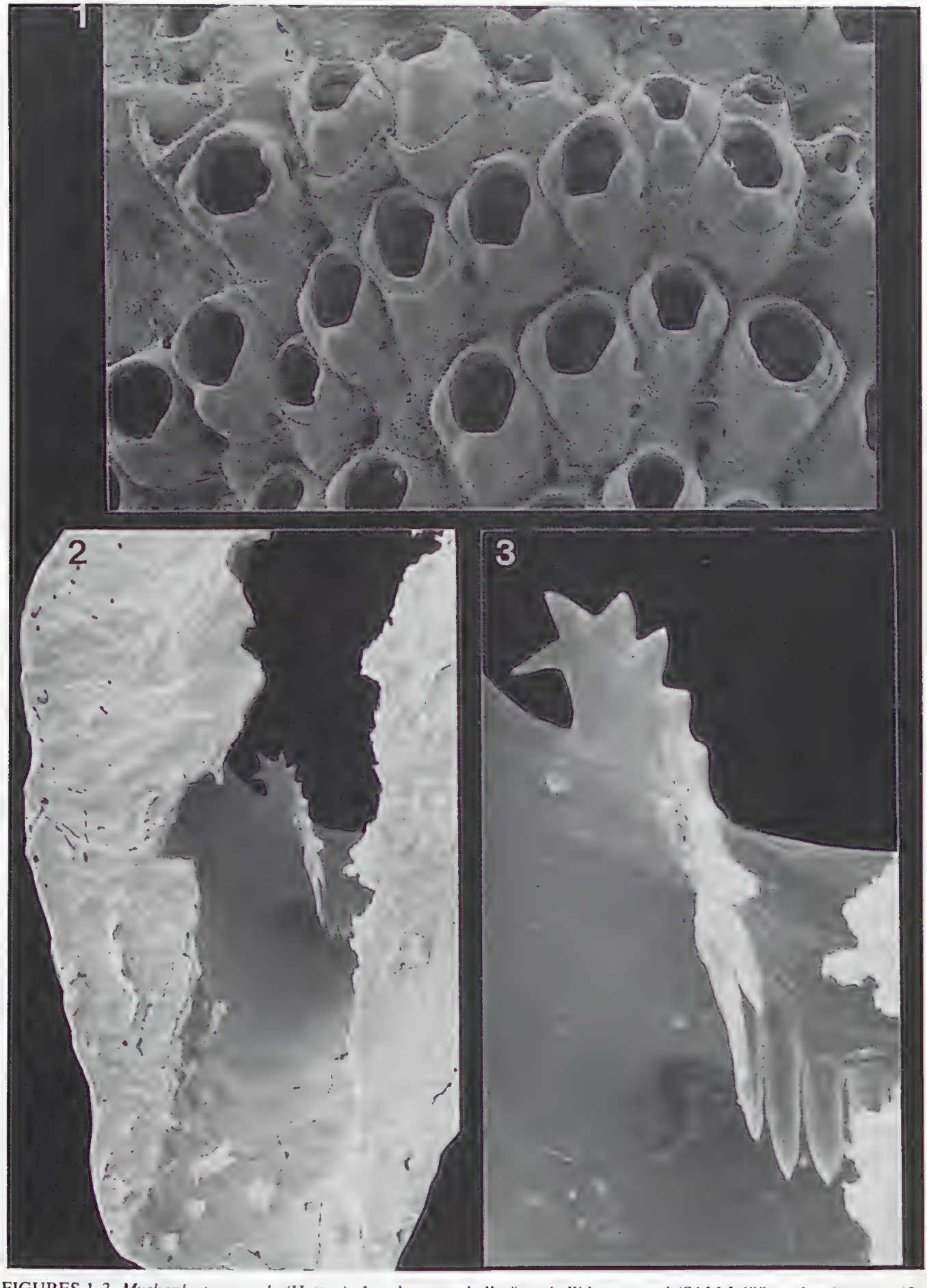
Lepralia pocula Hutton, 1878.

Mychoplectra pocula (Hutton)
(Figs 1–4)

Lepralia pocula Hutton, 1878: 24; Jelly 1889: 132.
Membranipora polita Hincks, 1880: 377; MacGillivray 1882: 118; Jelly 1889: 161.
Pyripora polita: MacGillivray *in* McCoy 1885: 24; 1887: 205; 1890: 2; Vigeland 1964: 169; Bock 1982: 343.

Material examined (localities all in South Australia)

South Australian Museum. Vials: SAM L475, 476, off Seacliff, Adelaide district, Gulf St Vincent, 11 m, coll. S. A. Shepherd, 28 Sept. 1968; L477, Port Elliot, Encounter Bay, undated; L490, no data. Slides: L189a,



FIGURES 1–3. *Mychoplectra pocula* (Hutton): 1, colony on shell of turritellid gastropod (SAM L490, no locality), × 40; 2 and 3, view of plectriform apparatus from within the zooid (paralectotype, OM A.88.160B, Gulf St Vincent, South Australia), × 275, × 890.

off Adelaide, 20–35 fms [37–64 m], coll. J. C. Verco, undated; L479–481, Glenelg, Adelaide, undated; L482, 'S. Aust.', undated. Spirit specimens: L483, West I., Encounter Bay, 3–5 m, coll. N. Holmes, 8 July 1988; L484, just E of The Bluff, Encounter Bay, upper subtidal, coll. K. L. Gowlett-Holmes and S. A. Parker, 18 July 1988; L488, Edithburgh, Yorke Peninsula, upper subtidal, coll. P. Hudson, 24–28 April 1989; L491, Port Victoria jetty, Yorke Peninsula, 1–2 m, coll. K. L. Gowlett-Holmes, 25 July 1989; L499, 5 Nm NW of Outer Harbor, Adelaide district, coll. N. Holmes, 7 Nov. 1989.

Otago Museum. Vials: OM A.88.160A, B, shores of Gulf St Vincent, coll. R. Tate (lectotype and paralectotype of *Lepralia pocula* Hutton).

N.Z. Oceanographic Institute. Vial: Stn Z6722, just E of the Bluff, Encounter Bay, upper subtidal, coll. S. A. Parker and T. Sim, 10 Feb. 1989.

Substrates

SAM L477 and L482 were on algae, L490 on a turritellid gastropod, and the remainder on stems of the sea-grasses *Amphibolis antarctica* and *A. griffithii*.

Description

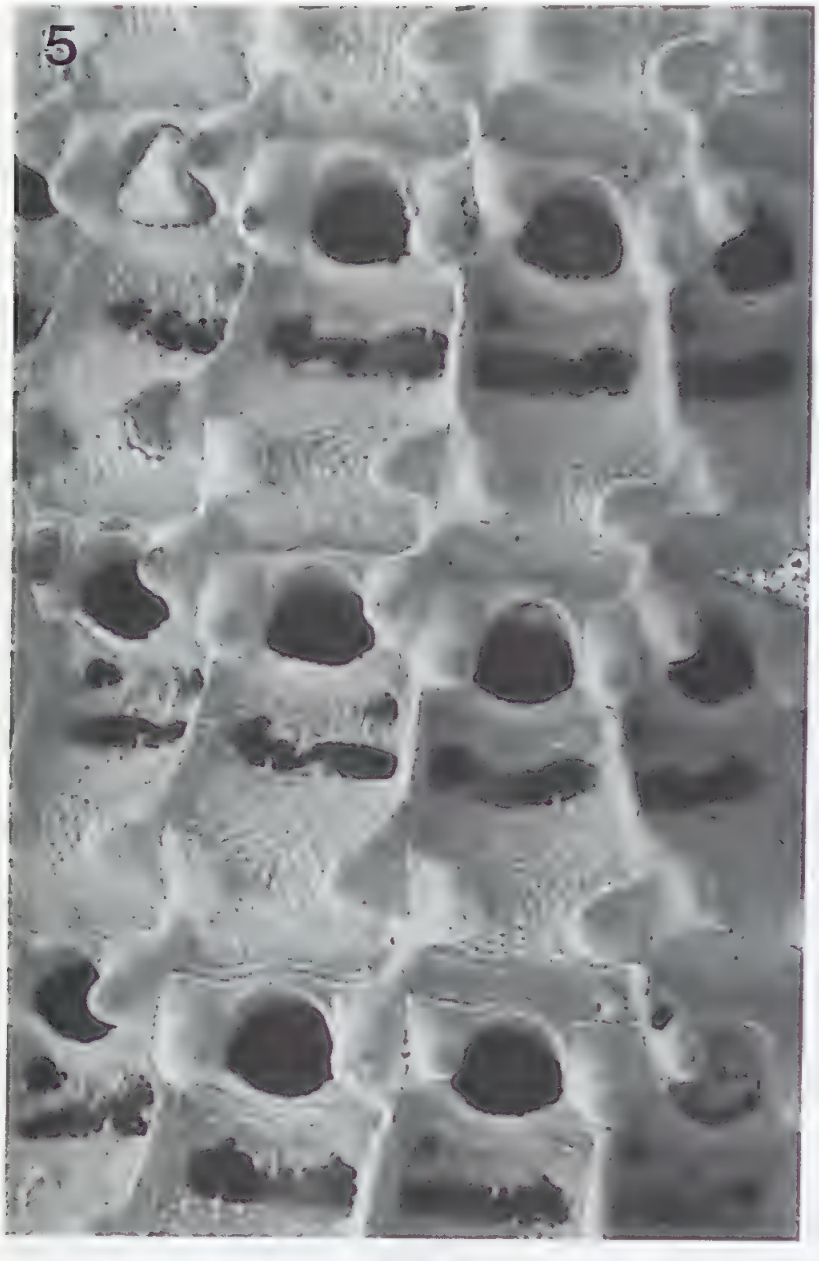
Colony encrusting, pluriserial, with short uniserial runners distally that also become pluriserial as the colony expands. Colour in life pearly white, often with a pinkish tinge from thinly encrusting and/or endozoic red algae. Zooids 0.32–0.64 × 0.17–0.32 mm, elongate-pyriform, often occurring in oblique rows depending on the substratum. Frontal surface a smooth, porcellaneous gymnocyst, sometimes with transverse growth-check lines proximally, that surrounds the variably subpyriform/suboval sunken opesia; frontal membrane set at angle of *ca* 20–45° to the plane of the substratum; gymnocyst with 3 large rounded eminences bordering the opesia, 2 lateral, with a larger swelling at the highest part of the frontal wall that overhangs the proximal part of the opesia and frontal membrane; the underside of the gymnocystal overhang with a prickled surface. Cryptocyst narrow, vertical, rarely shelf-like, not or scarcely developed proximally, with no or sparse granulations. Avicularia absent. Kenozooids present interzooidally (depending on crowding of zooids), with a variably shaped membranous area. Plectriform apparatus comprising a median scoop proximally recurved with distal teeth, and a pair of lateral spurs which may project into the opesia. Additional tiny spurs may protrude into the body cavity beneath the lateral cryptocyst. Calcareous spinous processes also arise from the inner side of the frontal gymnocyst proximally, projecting into the coelom. Generally 1–2 openings of narrow intramural basal pore-chambers present frontally. Polypide with 12 tentacles. No ovicells; zooids protogynous hermaphrodites, producing numerous non-brooded embryos. Ancestrula unknown.

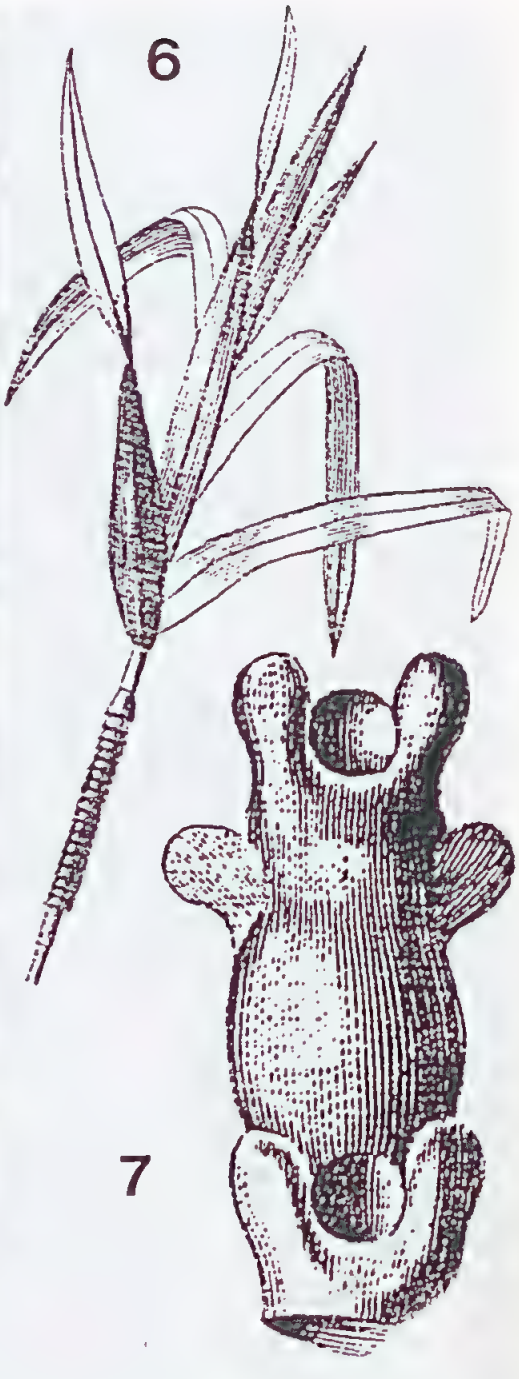
Remarks

Mychoplectra is established for this species and for '*Pyripora*' *crassa*, both of which are characterized by a plectriform apparatus. Like *Pyripora*, *Mychoplectra* has a well-developed gymnocyst, a partial cryptocyst, extensive area of membranous frontal wall, and kenozooids. Both genera lack oral or mural spines, avicularia, and ovicells. Whereas Recent *Pyripora* have discrete basal pore-chambers with a septular wall (these details unknown for the fossil type species), *Mychoplectra* has small tubular intramural chambers, comparable to those in *Hippothoa divaricata* (see Gordon & Hastings 1979, fig. 2, C), with a tiny uniporous septulum.

The earliest available name for the type species is *Lepralia pocula* Hutton, 1878, described without illustration, and subsequently overlooked. Recently, Hutton's collection from South Australia was discovered in the Otago Museum, Dunedin (Gordon & Parker 1991b). His specimens of *Lepralia pocula* were formally registered and a lectotype (A.88.160A) designated from the syntypes. It is not inconceivable that instead of *pocula* Hutton had meant to write the substantival form *poculum*. Even if this had been so, however, the spelling cannot now be corrected to *poculum*; for, there is in Hutton's original description no clear internal evidence of an inadvertent error, and no indication that *poculum* is the correct substantival form [see the International Code of Zoological Nomenclature, Article 32(c) (ii) (Ride *et al.* 1985: 68–69)]. We therefore suggest that *pocula* be retained, and treated as adjectival in form.

FIGURE 4. *Mychoplectra pocula* (Hutton): single zooid, with testes (left-hand side) and oocytes visible under the frontal membrane (NZOI Stn Z6722, near Victor Harbor, South Australia, from colony on stem of *Amphibolis antarctica*), × 105.





FIGURES 5–7. *Diploporella alata* (Lamouroux): 5, zooids from stem of *Amphibolis antarctica* (OM A.88.161, Gulf St Vincent, South Australia, Hutton Collection); 6 and 7, Lamouroux's (1821) illustrations of *Cellepora alata* on type material of *Amphibolis antarctica* from Esperance Bay, Western Australia.

In his account of Hincks' (1880) species *Membranipora polita*, MacGillivray (1882) commented that it probably ought to form the type species of a new genus, to include also *Hippothoa crassa* MacGillivray, 1869. While prescient, this was in contradistinction to *Membranipora*, not *Pyripora*, in which genus MacGillivray (*in* McCoy 1885) later included *M. polita*, and *H. crassa*. Concerning *M. polita* MacGillivray (1882) also stated, 'I have little doubt that it is identical with Lamouroux's *Cellepora alata*.' He repeated this assertion in McCoy (1885), in which he transferred the species to *Pyripora*. Jelly (1889), following MacGillivray, tentatively listed Lamouroux's (1821) species with *M. polita*. MacGillivray was in error, however. As suggested by Harmer (1926: 289), *Cellepora alata* is a senior synonym of the species currently known as *Diploporella cincta* (Hutton), formerly *Thairopora cincta* (Fig. 5) (see Soule *et al.* 1991). Both *Mychoplectra pocula* and *D. cincta* encrust stems of the cymodoceacean seagrasses *Amphibolis antarctica* and *A. griffithii* along the southern Australian coast. Lamouroux (1821, pl. 64, figs 10, 11) illustrated part of a leafy stem of *A. antarctica*, reproduced here (Fig. 4), showing zooids and a colony of an encrusting bryozoan (Figs 6, 7). *Mychoplectra pocula* and *Diploporella cincta* are two of only three bryozoan species [the other being *Electra flagellum* (MacGillivray)] to form regularly whorled zooidal rows

on *Amphibolis*, but Lamouroux's illustration cannot be of *Mychoplectra*, for the latter produces only oblique whorls, not regularly transverse ones (verticillate) as depicted by Lamouroux. Lamouroux's illustration of the zooids confusingly fails to show the cryptocyst of *D. cincta* but his description (1821: 2) makes it clear. He describes the zooids as '*gibbeuses inférieurement, avec deux appendices ptéroïdes sur leur parties moyenne et latérale; ouverture ronde avec un tubercule très-gros et mamilliforme de chaque côté.*' This is a description of zooids with the membranous frontal wall intact. The wing-like appendages correspond to the pair of smooth gymnocystal flaps, which encroach onto the convex cryptocyst; the mamilliform tubercles occur on either side of the subcircular orifice (Fig. 5). As Harmer (1926: 289) suspected, therefore, *Diploporella alata* (Lamouroux, 1821) is the correct name for this species. The type locality is Esperance Bay, Western Australia (Womersley 1984: 104). The type specimen would be on type material of *Amphibolis antarctica*, evidently housed at the Herbarium Universitatis Florentinae, Florence, Italy, but upon enquiry, the latter has been unable to be located.

Mychoplectra crassa (MacGillivray)
(Figs 8–10)

Hippothoa crassa MacGillivray, 1869: 130.
Pyripora crassa: MacGillivray *in* McCoy 1885: 23; 1887: 205; Vigeland 1964: 169.
Pyripora catenularia: MacGillivray (*non* Fleming) *in* McCoy 1885: 24, pl. 106, fig. 5; 1887: 205; Vigeland 1964: 169.

Material examined

South Australian Museum. Vials: L189b, off Adelaide, Gulf St Vincent, 20–35 fms [37–64 m], coll. J. C. Verco (undated); L485, Chiton Rocks near Victor Harbor, Encounter Bay, coll. L. Stach, 20 Nov. 1936; L486, Kangaroo I., no other data; L487, S. Aust., no other data; L489, between Backstairs Passage and The Pages, coll. J. C. Verco (undated); L500, Shell Rock, West I., Encounter Bay, coll. S. A. Shepherd, 18–19 Aug. 1967; L502, Price I., southern Eyre Peninsula, 17 m, coll. L. Hobbs, 28 Sept. 1989. Spirit: The Pages (islets), Kangaroo I., 15 fms [27.5 m], coll. K. Sheard, 12 April 1941.

Museum of Victoria. Slides (both labelled *Pyripora catenularia*): NMV F58646, Port Phillip Heads, Victoria, coll. J. B. Wilson; NMV F58647, Hobsons Bay, Victoria (no other details).

Substrates

L189b, L485–487 on red algae (including *Pterocladia lucida*); L489 on adeonid bryozoan (with *Turbicellepora redoutei*); L498 on stalk of brachiopod *Magellania flavescens*; L500 on hydroid; L502 on flat rounded pebble; F58646 on stem of ?hydroid; F58647 on angular pebble.

Description

Colony encrusting, uniserial, branching more or less cruciform, to pluriserial. Zooids 0.23–0.64 × 0.14–0.42 mm, elongate-pyriform, the proximal caudal portion short, truncated in laterally budded zooids, longer and tapering in distally budded zooids. Frontal gymnocyst smooth, sometimes with a thick porcellaneous protuberance immediately proximal to the membranous frontal wall; cryptocyst shelf-like, moderately developed, widest proximally, pustulose; frontal membrane set at shallower angles to substratum than in *M. pocula* (0–25°). Avicularia absent. Kenozooids may be present interzooidally, replacing autozooids at distolateral budding sites when crowding occurs, the opesia irregularly circular to oval. Plectriform apparatus similar to that in *M. pocula* but the distal spurs of the apparatus tend to be more often visible, with at least one protruding somewhat into the opesial space; tiny spur-like spines may occur sparsely on the lateral walls. Internal nail-like spines occur proximally under the gymnocyst. Small intramural basal pore-chambers present, up to 2 per side but the proximal pair may be suppressed. No ovicells. Ancestrula unknown.

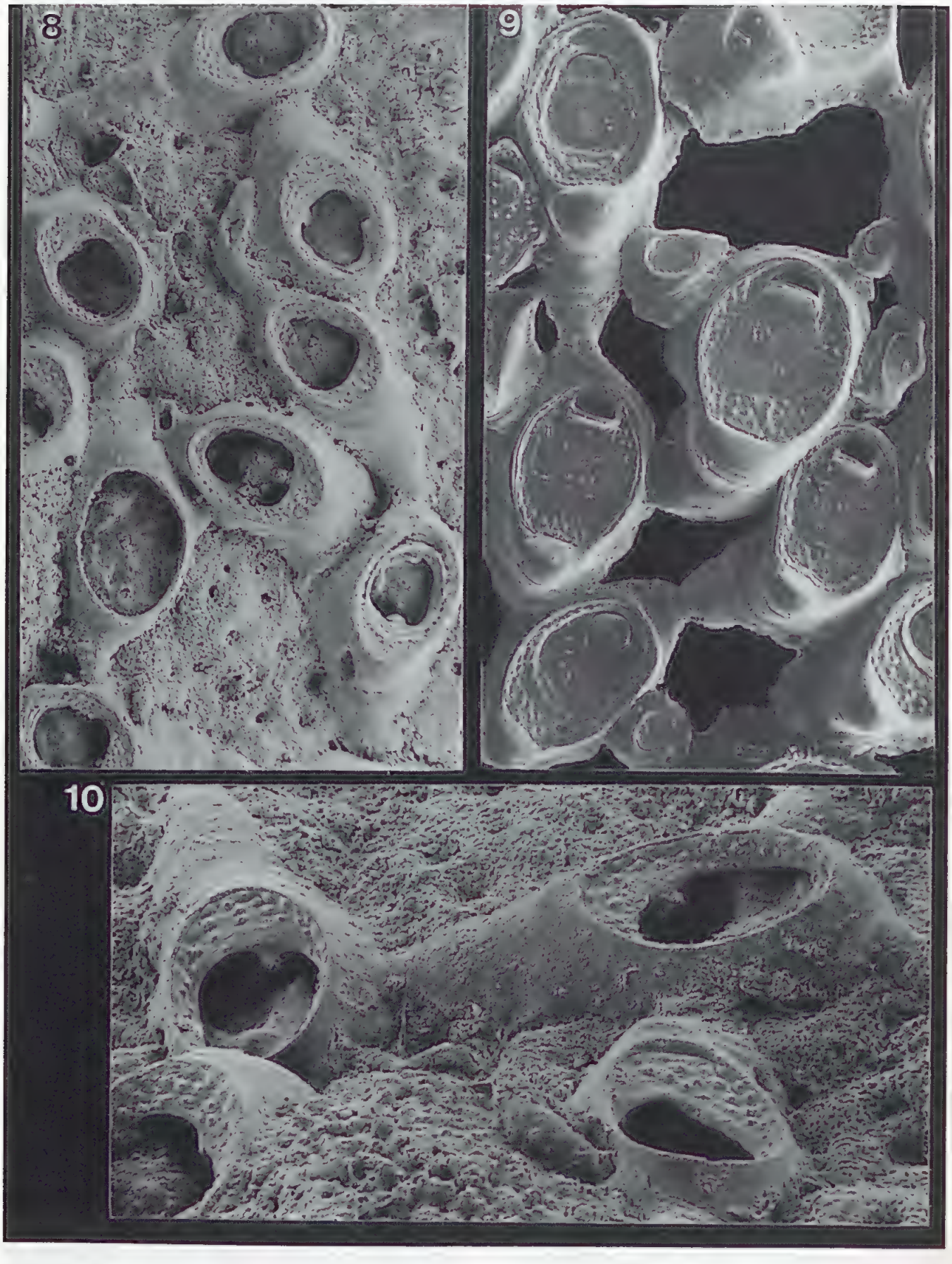
Remarks

Two types of zooids were evident in the colonies of *M. crassa* examined:

a) (Fig. 9) zooids possessing a protuberance on the gymnocyst proximal to the frontal membrane [corresponding to the 'thick lip-like projection' of MacGillivray (1869), MacGillivray *in* McCoy (1885)], the protuberance sometimes bearing a pit-like depression apparently covered with a membrane; some zooids showing additional gymnocystal thickening on the proximolateral margins of the opesia, though this thickening not encroaching over the frontal membrane as in *M. pocula*.
b) (Figs 8, 10) zooids lacking gymnocystal protuberances and thickenings, and outwardly resembling *Pyripora catenularia* (Fleming).

Type 'a' occurred in the colonies on the relatively flexible substrates (fronds and stems of red algae, hydroids and brachiopod stalk). Type 'b' occurred on the harder substrates (L489, adeonid bryozoan, and L502 and F58647, pebbles). In addition, colony L502 has many Type 'a' zooids and zooids intermediate between the two types, which leads us to regard them as expressions of the one species, *M. crassa*, rather than as representing different species.

Through the courtesy of Mr T. Stranks of the Museum of Victoria, we have been able to examine on loan two of the slides identified by MacGillivray as



FIGURES 8–10. *Mychoplectra crassa* (MacGillivray): 8 and 10, colony on adeonid bryozoan (SAM L489, between Backstairs Passage and The Pages, South Australia) × 80, × 115; 9, colony on red alga (*?Pterocladia lucida*) (SAM L485, Chiton Rocks, Encounter Bay, South Australia), × 170.

Pyripora catenularia (F58646, 58647, listed above). These colonies are both referable to *M. crassa*, the first having zooids of Type 'a', the second zooids of Type 'b'. MacGillivray's figure (in McCoy 1885) is also of type 'b', which differs from true *Pyripora catenularia* (Fleming 1828) of the north-eastern Atlantic Ocean by the possession of the plectriform apparatus, the proportionately larger cryptocyst and the beading of the mural rim less distinct to absent. Scanning electron micrographs of *P. catenularia* have been published in Taylor (1986).

Recent species of *Pyripora* appear to be restricted to the Northern Hemisphere (Ryland & Hayward 1977; Canu & Bassler 1929). *Mychoplectra*, on the other hand, is so far known only from the Southern Hemisphere. *Pyripora audens* Marcus, 1949 of Brazil is certainly a *Mychoplectra*, and from its external morphology *Membranipora eburnea* Hincks, 1891 (type locality '? Queensland') may also be congeneric.

Apart from the type species *P. pyriformis*, several other fossil species have been ascribed to *Pyripora* (*e.g.* by Canu & Bassler 1920; Thomas & Larwood 1956, 1960; Larwood 1973; Voigt 1982) and it would be instructive to examine the interior walls of these for a plectriform apparatus, which in *Mychoplectra pocula* appears to be a guide for the movements of the polypide (Gordon & Parker 1991a).

Reproduction

Details of reproduction in *Pyripora* are not known, though it is suspected of having a cyphonautes-type larva. In *Mychoplectra*, the only breeding information pertains to *M. pocula*. In South Australian waters, gonads are evident in colonies collected in February, and colonies have been found spawning in February, July and November. Testes and apparently mature oocytes occur in the same zooids. Oocytes are spherical, approximately 0.01 mm in diameter, and in living material are brownish-red and set in a clear gelatinous matrix; *ca* 30 or more are evenly distributed under the membranous part of the frontal wall.

The timing of maturation of gametes varies in electrids. *Electra pilosa* and *E. posidoniae* tend to be protandrous whereas in *E. crustulenta* male and female gametes mature simultaneously (Silén 1966). Up to 20 ova are produced by *E. posidoniae* (Silén 1966) and a much larger number by the membraniporid *Membranipora membranacea* (39 are illustrated) (Silen 1945). The cyphonautes larvae of these species have been illustrated by Ranzoli (1963) and Ryland (1964, 1965). A cyphonautes larva is presumed for *Mychoplectra*. Plankton-sweeps over *Amphibolis* beds around times of egg-release might reveal the larval form of *M. pocula*.

Acknowledgments

We should like to thank K. L. Gowlett-Holmes, N. Holmes, L. Hobbs, T. Sim and P. Hudson for assistance in collecting material, T. Stranks for the loan of specimens in the Museum of Victoria, and P. L. Cook, P. J. Hayward and J. S. Ryland for helpful comments on the manuscript.

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DISCOVERY AND IDENTITY OF 110-YEAR-OLD HUTTON COLLECTION OF SOUTH AUSTRALIAN BRYOZOA

D. P. GORDON & S. A. PARKER

GORDON, D. P. & PARKER, S. A. 1991. Discovery and identity of 110-year-old Hutton Collection of South Australian Bryozoa. *Rec. S. Aust. Mus.* **25**(2): 121–128.

A long-overlooked collection of bryozoans from South Australia described by Hutton in 1878 has been discovered and examined. Identifications are given for the species in the collection, with annotations. Although most of Hutton's names are junior synonyms of earlier-named species, two are senior and necessitate nomenclatural changes: *Adeonellopsis zietzii* (MacGillivray, 1889) becomes *A. baccata* (Hutton, 1878) and *Pyripora polita* (Hincks, 1880) becomes *Mychoplectra pocula* (Hutton, 1878).

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Examination of a collection of South Australian Bryozoa in the Otago Museum, Dunedin, New Zealand has yielded information on the identity of several nominal taxa that affects modern nomenclature. The collection, overlooked for 110 years, was discovered in 1988 following an enquiry from one of us (S.A.P.) as to its probable whereabouts.

Frederick Woollaston Hutton, an English-born and -educated geologist, was an important contributor to nineteenth-century New Zealand science. During his various appointments he had found it necessary to become a botanist and zoologist as well and described a wide range of organisms, including birds, fishes, molluscs, insects, worms, hydroids and Bryozoa. When, in 1876, he was appointed Professor of Natural Science at Otago University, he also had charge of the Otago Museum, which as Director and Curator he practically founded. While in this capacity, he received from Professor Ralph Tate, an Honorary Member of the Royal Society of Tasmania, a collection of bryozoans from the shores of Gulf St Vincent, South Australia. Hutton (1878) briefly described most of these, naming six as new. Unfortunately, none was illustrated and, probably for this reason, the identity of all but one of the new species has been unrealised. Further, the specimens remained unexamined in the Otago Museum for 110 years.

The collection comprises 20 species. Two are not mentioned in Hutton's (1878) paper whereas some other species mentioned in the paper are not in the collection. One to several specimens of each species was contained in a folded piece of paper with only a number to identify it. On a separate piece of paper in the same box as the specimens and in Hutton's faded inked handwriting was a key to the number with names alongside, the new species' names in pencil only (one new species-name was subsequently changed in Hutton's paper but identifiable nonetheless). All of the specimens have now been labelled and registered (numbered A.88.148 to A.88.172 in the Otago Museum register). All six of Hutton's new species are represented. Hincks (1881) recognised that one was a senior synonym of a species described by himself in 1880. Now that the identities of the remaining five are known for the first time, it is apparent that two currently used names will have to drop into synonymy.

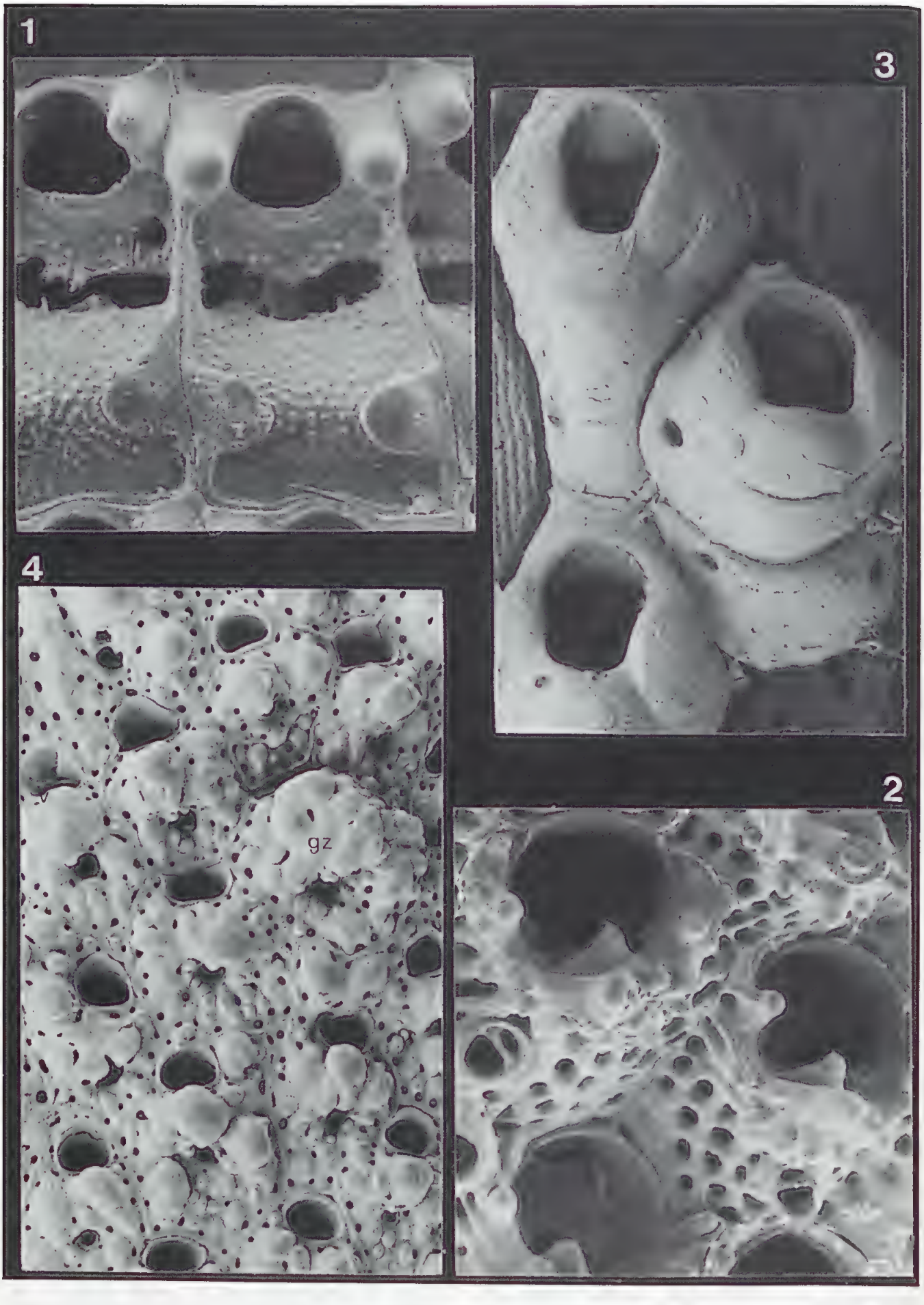
Revision of Hutton's List

In Hutton's (1878) three-page paper, 23 species are listed, nine of them (including the two resuscitated) accompanied by descriptive annotations. All are listed below, in the same order. For the 20 species still present in the Otago Museum collection, revised identifications are given where necessary. Registration numbers are given at the end of each entry.

1. *Caberea rudis:* ***Caberea grandis*** Hincks, 1881 [*non Amastigia rudis* (Busk, 1852)]. A.88.166.

2. *Membranipora lacroixi* [sic]. No specimen in collection. *M. lacroixii* Audouin, 1826 is currently regarded as a synonym of the extra-Australian *Conopeum reticulum* (Linnaeus, 1767).

3. *Membranipora* (?) *cincta:* ***Diploporella alata*** (Lamouroux, 1821), formerly *Thairopora cincta* (Hutton, 1878) (Fig. 1). Use of the generic name *Diploporella* MacGillivray, 1885a follows Soule *et al.* (1991), who reseparated this genus from *Thairopora*. Use of the trivial name *alata* follows Gordon & Parker (1991). *D. alata* is also a senior synonym of *Membranipora transversa* Hincks, 1880. A.88.161, holotype of *Membranipora* (?) *cincta* Hutton.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4. *Lepralia candida:* **Arachnopusia unicornis** (Hutton, 1873) [*non Fenestrulina candida* (MacGillivray, 1860a)]. A.88.163.

5. *Lepralia elegans:* **Adeonellopsis sulcata** (Milne Edwards, 1836) [*non Hippoporina elegans* (MacGillivray, 1860b)]. A.88.168.

6. *Lepralia tatei:* **Didymosella larvalis** (MacGillivray, 1869). A.88.158, holotype of *Lepralia tatei* Hutton.

7. *Lepralia spicea:* **Mucropetraliella ellerii** (MacGillivray, 1869) (Fig. 2). A.88.162, holotype of *Lepralia spicea* Hutton.

8. *Lepralia baccata*: **Adeonellopsis baccata** (Hutton, 1878) (Figs 4–7). Senior synonym of *Adeonellopsis zietzii* (MacGillivray, 1889). This little-known species, purplish in life, encrusts small algae and stems of the cymodoceacean seagrass *Amphibolis*. It is strictly encrusting, unlike the similarly coloured *A. sulcata*, which can begin as an encrusting form but later gives rise to bilamellar lobes. *Adeonellopsis baccata* is also readily distinguished from other *Adeonellopsis* species by its zooidal morphology – the autozooidal spiramen is single, sometimes slightly stellate, whereas that of the female zooid is compound, generally with three pores. Avicularia are rare, and the zooidal surface is knobbly, with cauliflower-like excrescences. A.88.159, holotype of *Lepralia baccata* Hutton.

9. *Lepralia pocula*: **Mychoplectra pocula** (Hutton, 1878) (Fig. 3). Senior synonym of *Membranipora polita* Hincks, 1880 and type species of the genus *Mychoplectra* Gordon & Parker, 1991. A.88.160A, lectotype and A.88.160B, paralectotype of *Lepralia pocula* Hutton (see Gordon & Parker, 1991).

10. *Cellepora agglutinans*: **Celleporaria cristata** (Lamarck, 1816). *Celleporaria agglutinans* (Hutton, 1873), widely distributed in New Zealand, is not known from Australia. In zooidal features the two species are very similar, but *C. cristata* typically forms bilamellar lobes with a crest. One of the most consistent differences between *C. agglutinans* and *C. cristata* is the insignificant or scarcely evident condyles of the autozooidal orifice in the former compared with the stout condyles in the latter (*cf.* Gordon 1989, plate 16D). Both species have a ligula on the crossbar of the columnar avicularium, like that in *C. fusca* (Busk, 1854), but *C. fusca* has a toothed rostrum (cf. Bock 1982, fig. 9.17d). A.88.167.

11. *Cellepora edax*: **Calyptotheca lata** (MacGillivray, 1883) [*non Hippoporidra edax* (Busk, 1859); *non Hippoporidra lusitania* (Taylor & Cook, 1981)]. A.88.156.

12. *?Cellepora tubigera*: **Celleporaria cristata** (Lamarck, 1816) [*non Turbicellepora tubigera* (Busk, 1859)]. A.88.152, 153, 154, 170.

13. *Eschara contorta*: **Parasmittina unispinosa** (Waters, 1889a) [*non Escharoides contorta* (Busk, 1854)]. A.88.172.

14. *Eschara* (?) *huttoni*: **Calyptotheca variolosa** (MacGillivray, 1869) (Fig. 8). Senior synonym of *Schizoporella biturrita* Hincks, 1884 and *Schizoporella baccata* Maplestone, 1913 (P. E. Bock, *in litt.* 1988); replacement name for Hutton's original *Eschara tatei*, preoccupied (*vide* Tate's footnote to Hutton 1878: 24). Illustrated by SEM as *Gigantopora biturrita* in Bock (1982; see also Bock's 1987 *Corrigenda*). A.88.157, holotype of *Eschara* (?) *huttoni* Tate *in* Hutton.

15. *Retihornera foliacea*: **Hornera foliacea** MacGillivray, 1869. A.88.175.

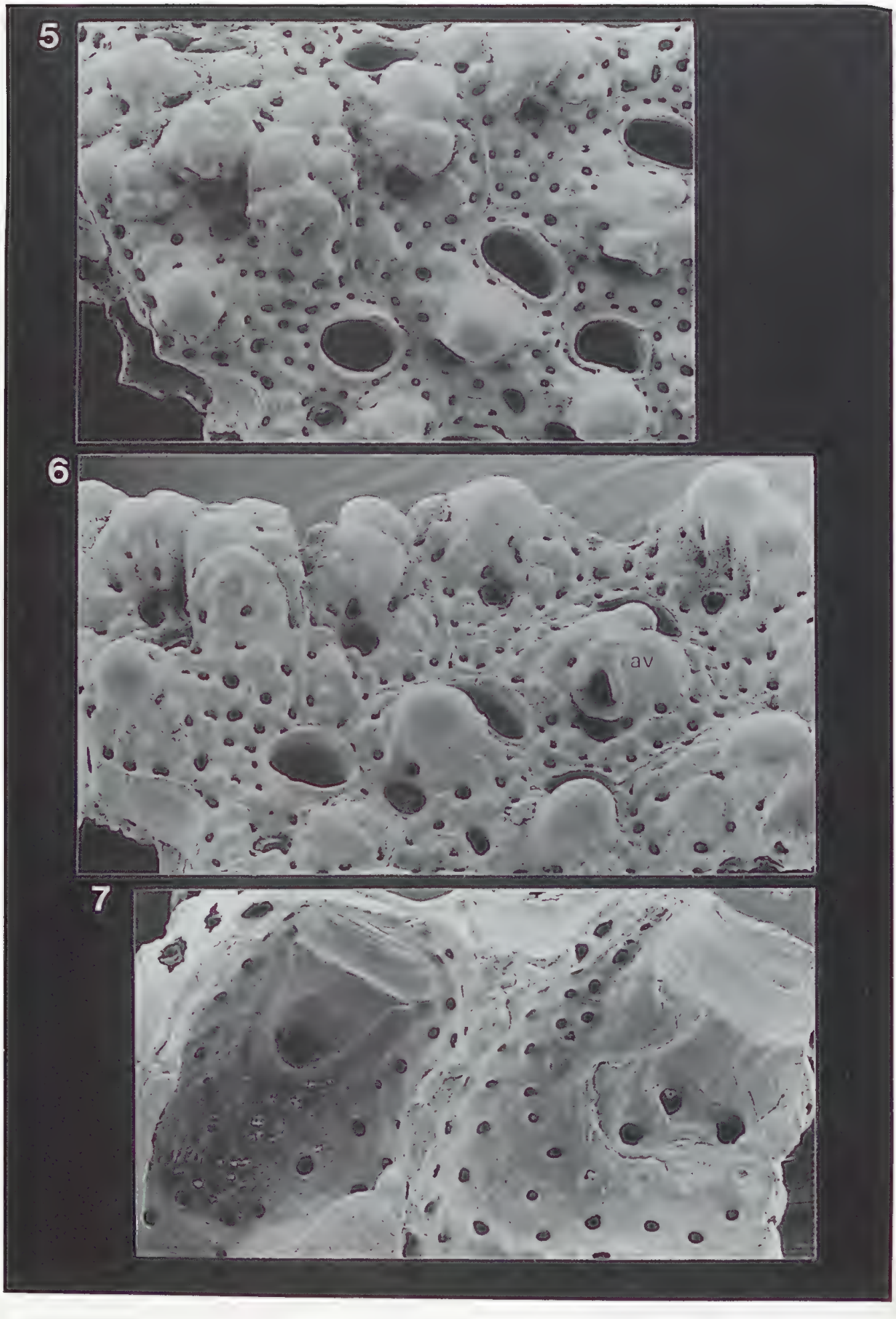
16. *Retepora cellulosa*: **Triphyllozoon munitum** (Hincks, 1878) (*non Retepora cellulosa* Smitt, 1868, *non* Linnaeus, 1758). A.88.165, 173.

17. *Retepora phoenica* [*sic*]: **Petralia undata** MacGillivray, 1869 [*non Iodictyum phoeniceum* (Busk, 1854)]. A.88.171.

18. *Vinculari* [*sic*] *maorica*: **Cellaria australis** MacGillivray, *in* McCoy, 1880: 48 (*non Vincularia maorica* Stoliczka, 1865, = *Chaperia* sp., *fide* Brown 1958: 39). A.88.169.

19. *Idmonea radians*: **Mesonea radians** (Lamarck, 1816) (Fig. 9). *Mesonea radians* (see Hastings 1932; Bock 1982) is the correct name for this species, which has often been referred to as *Crisina radians*. The type species of *Crisina* is *Crisina normaniana* d'Orbigny 1851, Cretaceous, Europe, which is clearly distinguished from *Mesonea radians*, a Recent species, by the distribution and arrangement of pores and by the construction of the ovicell (Voigt 1984). *Mesonea* (Canu & Bassler, 1920) has pores on frontolateral faces of branches as well as dorsally, and the ovicell has smooth, membrane-covered porous areas. *Crisina* has only dorsal pores in longitudinal furrows and the ovicell lacks the porous areas (Voigt *in litt.*, 1988). There appear to be several species from the Indian and Pacific Oceans, with a *Crisina*-like colony form, that have been attributed to *Crisina radians*. Waters (1887), Harmer (1915), and Bock (1982) have illustrated Lamarck's (1816) species, but those of Brood (1976) from East Africa, of Ryland (1984) from Fiji, and of Soule *et al.* (1987) from Hawaii are neither conspecific nor even congeneric with it. Clearly there is an amount of work to be done in sorting out the Indo-Pacific 'crisiniform' bryozoans. A.88.164.

FIGURES 1–4. **1.** Part of holotype, A.88.161, of *Membranipora* (?) *cincta* Hutton, = *Diploporella alata* (Lamouroux), × 105. **2.** Part of holotype, A.88.162, of *Lepralia spicea* Hutton, = *Mucropetraliella ellerii* (MacGillivray), × 80. **3.** Part of paralectotype, A.88.160B, of *Lepralia pocula* Hutton, = *Mychoplectra pocula*, × 80. **4.** Part of holotype, A.88.159, of *Lepralia baccata* Hutton, = *Adeonellopsis baccata*, showing one gonozooid (gz) surrounded by several autozooids, × 72. (All specimens from Otago Museum).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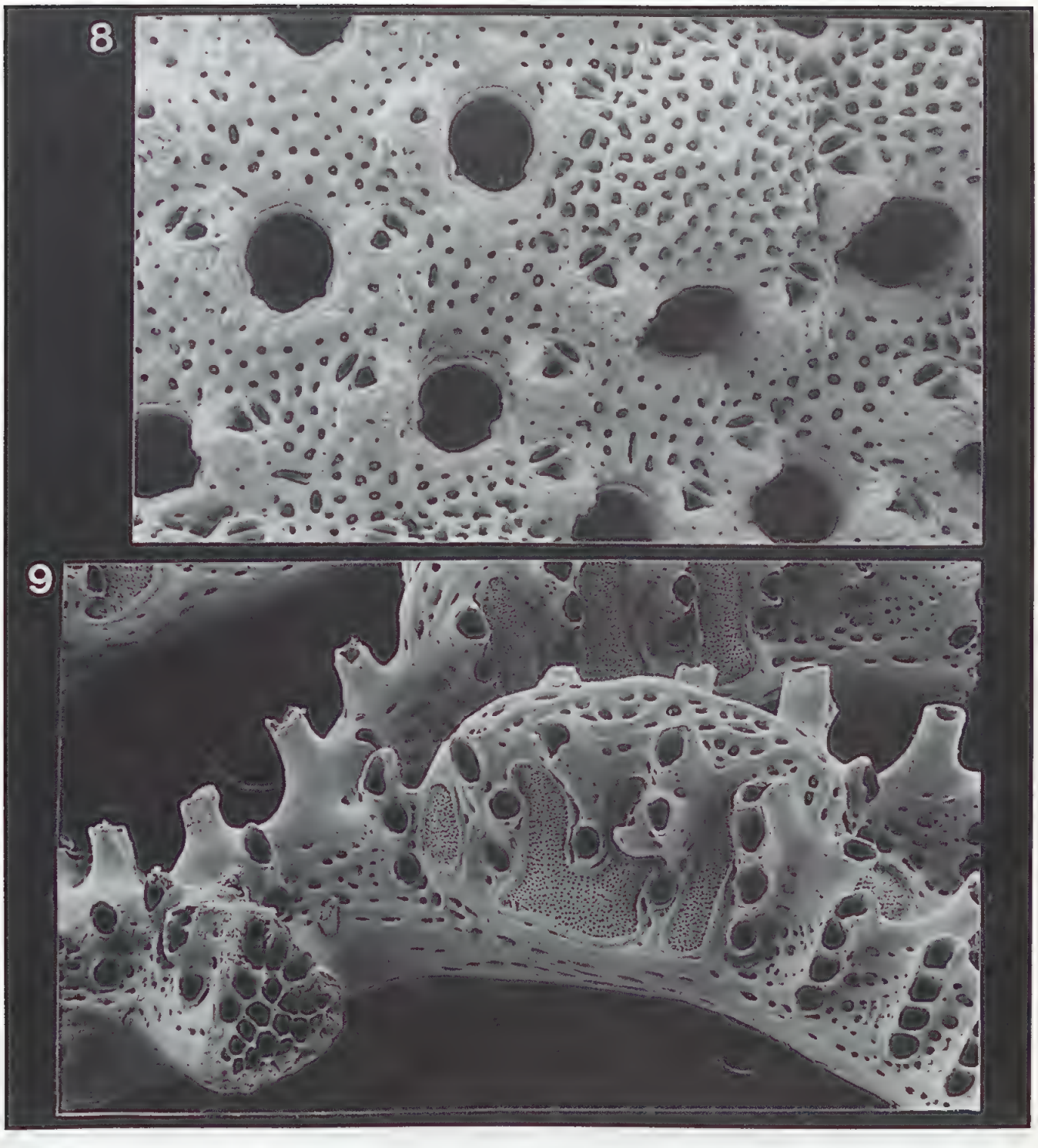
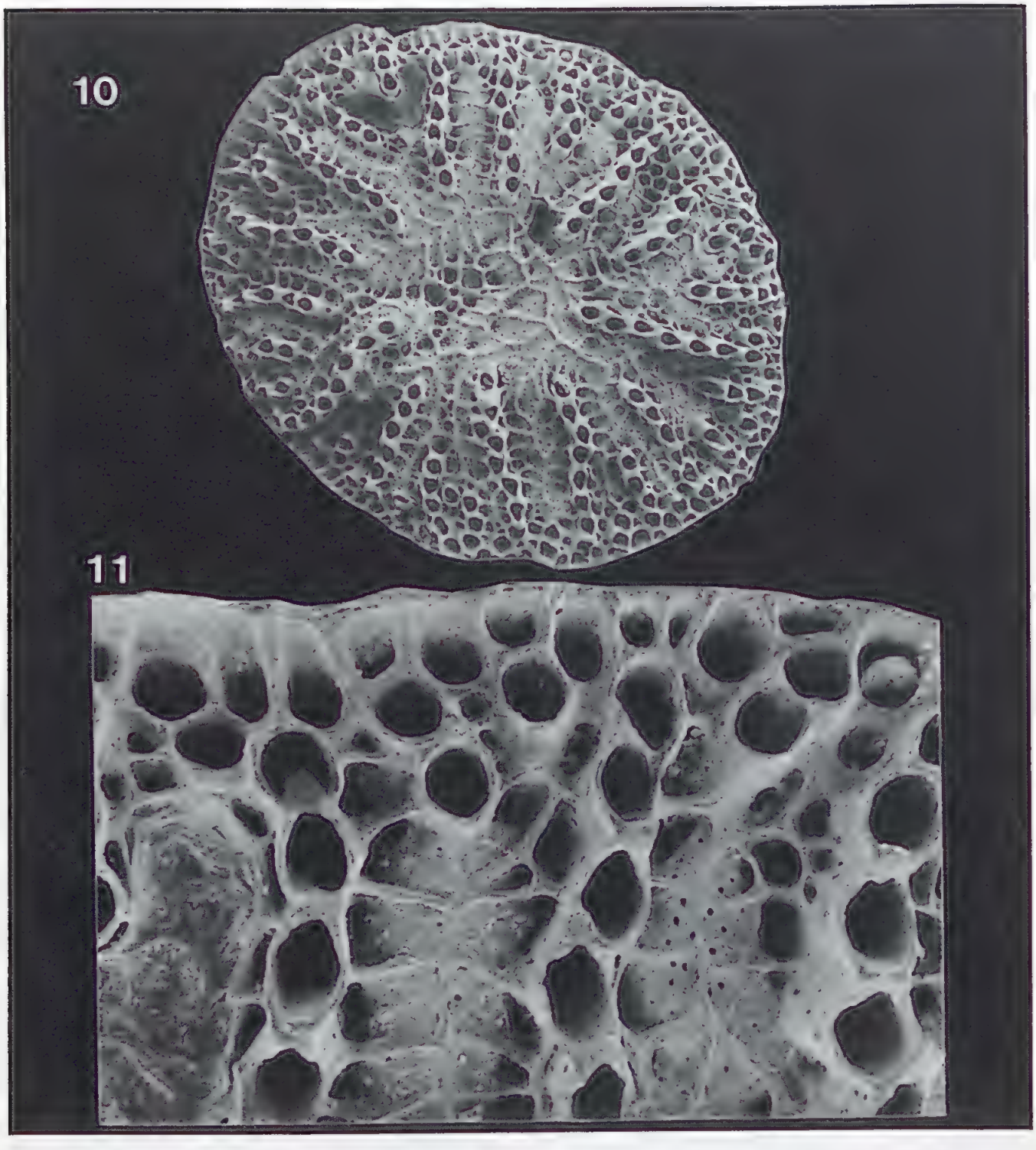


FIGURES 8 AND 9. **8.** Part of holotype of *Eschara* (?) *huttoni* Tate *in* Hutton, A.88.157, = *Calyptotheca variolosa* (MacGillivray), × 55. **9.** *Mesonea radians* (Lamarck), part of specimen A.88.164, showing brood chamber and peristome, × 53. (Both specimens from Otago Museum).

FIGURES 5–7. **5.** Part of syntype, SAM L460 of *Adeonellopsis zietzii* MacGillivray, = *A. baccata* (Hutton), showing a gonozooid (at left), with characteristic compound spiramen and several autozooids with simple spiramen; **6** is of the same specimen as in 5, but tilted to show an autozooidal avicularium (av), both × 105 (specimen from South Australian Museum). **7.** Part of holotype, A.88.159 of *Adeonellopsis baccata* (Hutton) showing the interior of the frontal shields of an autozooid (left) and a gonozooid (right), × 205.



FIGURES 10 AND 11. *Lichenopora victoriensis* Waters, specimen A.88.148, Otago Museum, showing the ramifying brood chamber (part magnified in 11), × 56, × 300.

20. *Pustulipora porcellanica*. No specimen in collection. Currently, this Hutton (1873) species is known only from New Zealand, as *Galeopsis porcellanicus* (Gordon, 1989). To date, the only species of *Galeopsis* definitely recorded for South Australia is *G. longirostris* (MacGillivray, 1885b) (specimens in South Australia Museum).

21. *Tubulipora flabellaris*. No specimen in collection. *Tubulipora flabellaris* (Fabricius, 1780) is an arctic-boreal species, unlikely to occur in Australia (Hayward & Ryland, 1985). There are several samples of *Tubulipora* from South Australia in the South Australian Museum, none identified to species. Six species of the genus have been reported from Victoria.

22. *Discoporella novae-zealandiae* [sic] : ***Lichenopora victoriensis*** Waters, 1889b [*non Lichenopora novaezelandiae* (Busk, 1875)] (Figs 10, 11). A.88.148, 150.

23. *Discoporella fimbriatae* [*sic*]: ***Lichenopora echinata*** (MacGillivray, 1884) [*?non Disporella fimbriata* (Busk, 1875)]. (*Cf.* Waters 1889b: 282 – "A 'Challenger' specimen from Tristan da Cunha was submitted to me named *L. fimbriata*. This is *L. echinata* with an ovicell, so that the name *fimbriata* must be dropped"). A.88.149, 151.

Two additional species, not mentioned in Hutton's (1878) paper, are represented in the collection. These are *Steginoporella chartacea* (Lamarck, 1816), syn. *S. truncata* (Harmer, 1900) (A.88.174) and *Rhynchozoon* sp., possibly *R. delicatulum* (MacGillivray, in McCoy 1890: 356) (A.88.155). For the priority of *Steginoporella chartacea* over *S. truncata* see d'Hondt 1979: 18, 20.

Two of Hutton's (1878) names are senior synonyms of later-described species. Thus, *Adeonellopsis zietzii* MacGillivray, 1889 becomes *A. baccata* (Hutton, 1878), and *Pyripora polita* (Hincks, 1880) becomes *Mychoplectra pocula* (Hutton, 1878).

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We sincerely wish to thank John Darby and Tony Harris of the Otago Museum for locating the Hutton Collection and making it available for study, P. Bock of the Royal Melbourne Institute of Technology for comments on *Calyptotheca variolosa* and *Schizoporella baccata*, and J. S. Ryland and P. J. Hayward for their critical reading of a draft.

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THE KARANGURA LANGUAGE

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AUSTIN, P. 1991. The Karangura language. *Rec. S. Aust. Mus.* **25**(2): 129–137.

This paper examines the linguistic position of Karangura, an Aboriginal language once spoken to the north-east of Lake Eyre in South Australia. The language occupied a crucial geographic position between three major linguistic groups in the region. The paper analyses the few existing sources on Karangura to determine its relation to these other languages. The fullest known vocabulary of Karangura is presented.

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The area to the east and north of Lake Eyre was traditionally one of some linguistic diversity. In the region along the Warburton Creek and Diamantina River from Lake Eyre to the current Queensland border we find three groups of languages represented:

1. Wangkangurru – this language is closely related to Arabana, spoken to the west of Lake Eyre (Hercus 1990);

2. Ngamini and Yarluyandi – these two languages were closely related to one another and were also genetically close to Diyari and Thirrari spoken further south along Cooper Creek and the eastern shore of Lake Eyre (see Austin 1981, 1990a,b; Breen 1971: 184);

3. Wangkamadla (or Wangkamanha) – this was the most southerly dialect of the western division of the Pitta-Pitta group of languages (Blake 1979: 184).

The question is: where does Karangura, occupying as it does a position bordering on all three language groups, fit into the linguistic picture of northern South Australia? In this paper I examine all the available linguistic evidence on Karangura in an attempt to answer this question. My study thus complements the historical and ethnographic research on Karangura that Hercus has undertaken.

The Karangura Language

There are just three sources of data on the Karangura language, all of them old historical documents:

1. a vocabulary published in Wells (1894);

2. five words collected by Pastor Carl Schoknecht sometime between 1871 and 1873 (see Schoknecht 1947);

3. a few words in Reuther's monumental dictionary of Diyari (see Reuther 1981).

In the following sections each of these sources is examined in detail.

Wells' Data

Appended to Wells' (1894) paper on Aborigines of the Diamantina, Herbert and Eleanor Rivers is a section entitled 'Dialect' which gives a listing of 217 English words and their correspondences in the 'Native dialect'. The transcription of the Karangura words is quite good, essentially being a naive adaptation of English spelling. There are three notable features of Wells' transcriptions:

1. The use of the symbol ā, primarily at the end of words. This seems to indicate that Wells felt the final Karangura low vowel was longer and clearer than the English final vowel typically signified by a in English spelling, namely schwa.

2. The use of the symbol ă, primarily in unstressed syllables to signify the low vowel.

3. The transcription of initial velar nasal *ng* which appears in Wells' list as 'm', as in items 12, 13, 28, 58, 65, 74, 101, 119, 123, 170, 189; as 'n', in items 88, 207; or is simply omitted, as in items 32, 95, 135, and 147.

There are a number of forms which suggest that Wells did not have a good grasp of the language, and that he must have elicited the vocabulary by pointing to various objects. There are also simple mistakes which suggest that the Karangura speaker(s) being interviewed did not understand Wells' English prompt (see for example 'heart', 'moths', and 'no', below). We can see this by comparing some of the forms and glosses he gives with corresponding words in Ngamini.[1] Simple errors such as the following are indicative of the danger of taking Wells' list at face value without examining comparative data:

Wells vocabulary		Ngamini	Gloss
'bark of tree'	yet-an-na	*yatha-rna*	'to speak, say, bark (of dog)'
'dig'	tap-poo-lee	*thapili*	'to drink'*
'frown'	boo-choo	*puju*	'blind'
'heart'	wal-derrā	*waldrra*	'hot'
'moths'	mi-attā	*mayatha*	'boss'
'no'	wo-bā	*wapa*	'go-imperative'
'spider'	mutta-nā	*matha-rna*	'to bite'
'thighs'	wil-yi-ri	*wilyirri*	'buttocks'
'thunder'	mik-arrie	*mikiri*	'desert well'
'thirsty'	won-koola	*wangku-lha*	'nothing-now'
'wet'	kung-oo	*kangu*	'sweat'

* This is the purpose-different subject form of *thapa-* 'to drink'. It would occur in the Ngamini translation of sentences such as 'Dig the ground for water (for me) to drink!' (see below).

Classification of Karangura

There is sufficient information that can be extracted from the Wells vocabulary to show that Karangura was very closely related to Ngamini, though not identical to it. There is both lexical and grammatical evidence to support this classification of Karangura. Firstly, there are a number of lexical terms found in Wells' list that resemble words peculiar to Ngamini that are not shared with its close genetic neighbours Diyari, Thirrari and Yarluyandi. Also, there is evidence of certain grammatical forms that are only found in Ngamini. This evidence follows, as well as indicators of Karangura's distinctiveness from the Ngamini language.

1. Peculiar lexical items

There are five words in Wells' list that are cognate with words otherwise peculiar to Ngamini:

Wells	Ngamini	Diyari	Gloss
'dam-poo'	*dampu*	*karlu*	'testicles'
'kul-tā'	*karla*	*darla*	'skin'
'par-koo-oona'	*parrkuna*	*mandrru*	'two'
'parkoo-oona-oona'	*parrkuna ngunha*	*parrkulu*	'three' (lit. 'two one' in Ngamini)
'tip-pă'	*thipa*	*thuju*	'snake'

2. Grammatical forms corresponding to Ngamini forms

Here we have four pieces of evidence: the ergative case affix, the participial verb inflection, the purpose-different subject verb inflection and the verb nominalising derivation:

(a) The ergative case affix:

All the eastern Lake Eyre languages have a case inflection, which we term the ergative, that is suffixed to nouns marking the transitive subject and instrument functions. This case marker has the following forms:

Diyari	*-ndrru*	added to female personal names
	-(ya)li	added to all other nouns
Yarluyandi	*-li*	added to dual and plural nouns
	-ndu	added to all other nouns
Ngamini	*-li*	added to dual and plural nouns
	-nu	added to all other nouns

There are some examples in Wells' list of ergative case-marked nouns showing *-nu*, as in Ngamini[2]:

Wells	Ngamini	Diyari	Gloss
'munthă-unoo'	*muntha-nu*	*muntha-li*	'shame-erg'
'moo-an-oo'	*muwa-nu*	*mawa-li*	'hunger-erg'

(b) The participial inflection:

In Diyari the participial affix added to verbs is invariant and has the shape *-rna*, and in Yarluyandi it is invariably *-rnda*. Ngamini has a number of different forms, depending on the phonological shape of the stem to which it is attached (see Austin 1990a for details). Thus, most vowel-final stems take *-rna*, while verb stems ending in C*i*, (where C is a nasal consonant) delete the C*i* and add *-nda*. Thus the participial form of *mani-* 'to get' is *manda*, and of *pirnani-* 'to become big' is *pirnanda*. The participial form of *pali-* 'to die' is *palda*. With reflexive verbs there are two possibilities which occur in free variation: V-*jarrhirna* or V-*janda*, for example 'to see oneself' is either *nhirrkajarrhirna* or *nhirrkajanda*. Examples from Wells' vocabulary show that Karangura had the Ngamini patterns:

Wells	Ngamini	Diyari	Gloss
'mirra-chuntā'	*mirrhajanda*	*mirrhatharrhi-rna*	'scratch oneself-ptcple'
'muckoo-munda'	*manda*	*mani-rna*	'get-ptcple'
'pul-tā'	*palda*	*pali-rna*	'die-ptcple'

Interestingly, part of this typical pattern of variation in verb forms in Ngamini and Karangura is shared with Wangkangurru where the present tense inflection is normally *-(rn)da* but verbs ending in a nasal plus *i* delete the final syllable and add *-nda*, as in *mani-* 'to get', present tense form *manda* (see Hercus 1990).

(c) Purpose-different subject verb inflection:

All the languages in the Lake Eyre region have the syntactic device of switch-reference, that is, an indication in dependent verb inflections of the sameness or difference of subjects across clauses. Thus, to express purpose there are two inflections: one for same subject and another for different subject. The forms of these inflections characteristically differ in the different languages:

	Diyari	Thirrari	Ngamini	Yarluyandi
purpose				
-same subject	*-lha*	*-lhali*	*-lha*	*-lhangga*
-different subject	*-rnanthu*	*-yani*	*-ili*	*-li*

There is one example in Wells' list that we can analyse as a purpose-different subject form, and it shows an affix cognate with Ngamini. The example is 'dig' – 'tap-poo-lee' – which clearly corresponds to Ngamini *thapili (thapa-ili)* 'drink-purpose-different subject'. Probably the Karangura speaker responded to Wells' prompt 'dig' with a sentence like '(You dig for water for me) to drink', only the last element of which ('drink-purpose-different subject') Wells was able to catch and write down. In any case, the form is clearly the same as in Ngamini.

(d) Nominalising derivation:

The languages to the east of Lake Eyre can form instrument nouns out of verbs by adding a nominalising derivational affix. In Diyari and Yarluyandi the form of this affix is *-ni* (see Austin 1981: 162), as in the Diyari example *pawa daka-ni* 'seed grinder' (where *pawa* is 'seed' and *daka-* is 'to grind'). In Ngamini the corresponding affix is *-ini* where the initial *i* replaces the final vowel of the verb stem (thus *puwa dakini* 'seed grinder'). There is one example in Wells' list which shows the Ngamini pattern, namely 'handcuffs warika-mun-drini', which we can analyse as *warrkamandrrini*, the nominalised form of *warrkamandrra-*, 'to tie up' (Diyari would have *warrkamandrrani* here).

3. Linguistic Distinctiveness from Ngamini

Karangura as recorded by Wells differs, however, in two interesting respects from Ngamini as recorded both in early sources such as Reuther and also in recent materials collected by Breen and myself. One of the differences is in the area of vocabulary, and the other is phonological:

(a) Vocabulary differences:

Although there are clear Ngamini cognates for almost all the words recorded by Wells (see below) and items otherwise unique to that language (see above), there are also sixteen items which differ from Ngamini and have cognates in Wangkangurru. Of great interest in this respect is the fact that most of these also have cognates in Thirrari (or 'Tirari') as recorded by Reuther[3], suggesting the existence of a local pool of lexical items shared between Thirrari, Wankgangurru and Karangura. These items are as follows:

Wells	Tirari	Wangkangurru	Ngamini	Gloss
'bul-yā arms'		*palyā*	*nguna*	'upper arm, wing'
'euka-an-ri'	'wapanta'	*yuka-*	*wapa-*	'to go'
'kulyi-erra womb'		*kalyara*		'placenta'
'moo-yoo-untā sunrise'		*muyu winta*	*diji winda*	'sunset'
'mumpoo-kaddi'	'mampukati'	*mampukardi*	*thinthipirri*	'elbow'
'mundōo-rainā'		*mantura-rda**		'to snore'
'oon-too'		*unthu*	*kini*	'penis'
'pe-pe yes, I know'		*piyi*	*kawu*	'yes'
'pim-ma'	'pima'	*pima*	*mimi*	'lip'
'pre-tanā I kill you'**	'tantata'	*pirta-rnda*	*dandrra-rna*	'to hit, kill'
'queei'		*kuya*	*mankarrha*	'girl'***
'tee-rankoo'		*thirrangkurda*		'how many?'
'tunya-anna licking'	'tanjana'	*thanyana*	*tharli*	'tongue'
'u-rā'		*yurrha*		'rump'
'wee-i'		*wiya*	*kanku*	'boy'***

* This verb occurs in the eastern dialect of Wangkangurru only.

** Notice that the root of this word is apparently cognate with Wangkangurru but that it seems to contain the participial affix cognate with Ngamini *-rna* (*cf.* Wangkangurru *-rnda*).

*** Hercus points out that Wangkangurru *kuya* is also pronounced *kuyayi* and *wiya* is also pronounced *wiyayi*. These two words were borrowed from Lower Southern Aranda and probably spread along with the Warrthampa ceremony [see Hercus (1991), this volume].

(b) Phonological differences:

In Ngamini there occur intervocalic clusters of post-alveolar continuant plus peripheral stop, *i.e. rk* and *rp*. These do not occur in neighbouring languages and correspond to *lk/rlk* and *lp/rlp* in cognates in Diyari and Yarluyandi. That is, Ngamini has merged the apical laterals as *r* before *k* and *p* (see Austin 1988: 242ff). In Wells' data the laterals have *not* changed to *r*, showing that Karangura was conservative like Diyari and Yarluyandi. Some examples are:

Wells	Ngamini	Diyari	Gloss
'bil-pa'	*pirpa*	*pilpa*	'eyebrow'
'mil-ki'	*mirki*	*milki*	'eye'
'pool-kanna'	*parka-rna*	*parlka-rna*	'to travel'
'pool-ko-annā'	*purka-rna*	*purlka-rna*	'to blow'
'thalpoo'	*tharpa*	*tharlpa*	'ear, leaf'
'wal-poo'	*warpu*	*(muku)*	'bone' (*cf.* Wangkangurru *warlpu)*
'wil-prinnā'	*wirpa-rna*	*wirlpa-rna*	'to whistle'

On the basis of these similarities and differences we can say that Karangura was closely related to Ngamini but showed a number of interesting differences that point to areal characteristics shared with Wangkangurru and Thirrari.

Wells' Vocabulary of Karangura, With Corresponding Ngamini Forms

	English	Native	Ngamini
1.	ants	merri-kā	*mirrka*
2.	arms	bul-yā	(Wangkangurru cognate)
3.	anus	milyerrie	*milyirri*
4.	bad	moo-dă	
5.	bag	yak-kootā	*yakutha*
6.	bark of tree	yet-an-na	*yatha-rna* 'to speak, say, bark (of dog)'
7.	big	tip-pee	*thipi* 'alive'
8.	bite	mut-tănnā	*matha-rna*
9.	bone	wal-poo	*warpu* (*cf.* Diyari *muku*, Wangkangurru *warlpu*)
10.	boy	wee-i	(Wangkangurru cognate)
11.	blood	koo-marri	*kumarrhi*
12.	beard	mun-ka	*ngarnka*
13.	breasts	mum-ma	*ngama*
14.	bread	mulya-mi	*malyumayi*
15.	brother	noo-yoo	*nhuyu* 'elder brother'
16.	blowing	pool-ko-annā	*purka-rna* (*cf.* Diyari *purlka-rna*)
17.	billycan	warra chuna	*warrajanda* (participial form of *warra-jarrhi-* 'to hang')
18.	bottle	koo-poola	*kupula*
19.	boot	tidna-bootā	*thina puta*
20.	calf	wirri-pā	
21.	cane grass	bree-ta	*pirta* 'tree'
22.	calves of legs	pur-rita	
23.	cutting	dum-an-nā	*dama-rna*
24.	cold	krip-pā	*kirpa*
25.	crying	indra-na	*yindrra-rna*
26.	cheeks	nal-ya	
27.	chest	pitta-witta	
28.	chin	munka-chedda	*ngarnkajarra*
29.	copi (gypsum)	wal-yoo	*walyu* 'ground, earth'
30.	come back	tik-annā	*thika-rna*
31.	come along	kowi	
32.	cow	ammā-milki	*ngama milki*
33.	crayfish	koon-tā	*kintha*
34.	crane	poo-ral-koo	*purrhalku* 'brolga'
35.	crow	koo-kunta	*kukunka* 'hawk species' (*cf. kawalka* 'crow')
36.	clean	warroo-koo	
37.	deaf	ya-ree	(*cf.* Wangkangurru *yarri* 'ear')
38.	dark	meel-ya-roo	*milyaru* 'dark, night'
39.	dog	terri-tā	*thirritha*
40.	dead	pul-ta	*palda* (participle of *pali-* 'to die')
41.	dig	tap-poo-lee	*thapili* (purpose-different subject of *thapa-* 'to drink')
42.	diver (bird)	woochoo-buk-anni	*wujupakarni*
43.	devil	koo-choo	*kuji*
44.	dress	broo-ka	*puruka* (loan from English 'frock')
45.	dust	woo-too-roo	*puthurrhu*
46.	damper	wai-mal-ya	*wayimalya*
47.	dirty	warroo	*warrhu* 'white'
48.	eyes	mil-ki	*mirki* (*cf.* Diyari *milki*)

	English	Native	Ngamini
49.	elbow	mumpoo-kaddi	(cf. Wangkangurru *mampu-kardi*)
50.	eyebrows	bil-pa	*pirpa* (*cf.* Diyari *pilpa*)
51.	eyelashes	milkie-wirrie	*mirki wirri*
52.	emu	warra-katchie	*warrkaji*
53.	excreta	koona-oonā	*kuna-kuna*
54.	eucalyptus	bulka-kulla	
55.	earth	purra-ka	
56.	fish	warrie	*wari*
57.	flame	yap-pinna	*yapi-rna* 'to burn, ignite'
58.	forehead	mool-loo	*ngulu*
59.	feet	tid-nā	*thina*
60.	fingers	murrā	*mara* 'hand, finger'
61.	fat	wom-mā	*wama*
62.	fur	mul-ta	
63.	fire	too-roo	*thurrhu*
64.	fly	moon-choo	*munju*
65.	father	mul-pi	*ngarpi* (*cf.* Diyari *ngapiri*)
66.	frown	boo-choo	*puju* 'blind'
67.	four	wi-tā	*wita* 'many'
68.	feathers	kurl-yā	
69.	gammon	wong-koo	*wangku* 'none, nothing'
70.	grass	win-thee	*winthi*
71.	grub	mool-yi	
72.	girl	queei	(Wangkangurru cognate)
73.	go on	koppa-ri	*kaparrha* 'come here!'
74.	give	munki-ammi	*ngangki-yamayi* 'give-imperative'
75.	go back	tik-anna	*thika-rna* (*cf.* 30)
76.	gun	mukitta	*makita* (loan from English 'musket')
77.	go away	euka-an-ri	(Wangkangurru cognate)
78.	galah	killān killi	*kilankila* 'galah'
79.	hair	moo-doo	*ngurdu* 'head'
80.	hat	oo-too-manēr-rie	*witiminirri*
81.	hit	tun-dera-nā	*dandrra-rna*
82.	heavy	muckoo-munda	*maku manda* 'to lift' (participle of *mani-* 'to get')
83.	hungry	moo-an-oo	*muwa-nu* 'hunger-ergative'
84.	hole	koo-doo	*kurdu*
85.	hold on	karrā	*karrha* 'hold-imperative'
86.	hand	murră	*mara* (*cf.* 60)
87.	heel	tidna	*thina* 'foot' (*cf.* 59)
88.	head	noo-doo-tun-derra	*ngurdu thandrra* (*cf.* 79)
89.	heart	wal-derrā	*waldrra* 'hot'
90.	hole thro' nose	moodla-wilpa	*mulha wirpa*
91.	handcuffs	warika-mun-drini	*warrkamandrrini* (nominalised form of *warrkamandrra-* 'to tie up')
92.	head dress	multărrā	*maltharra* 'bunch of feathers'
93.	how many	tee-rankoo	(Wangkangurru cognate)
94.	iguana	wump-pikka	*wampirrka*
95.	I don't know	a-nă-goo	*nganaku*
96.	I kill you	pre-tană	(Wangkangurru cognate)
97.	intestines	murrangarra	
98.	kangaroo	choo-koo-roo	*jukurrhu*
99.	knees	bun-chā	*panja*
100.	knife	ni-pā	*nhayipa*
101.	kissing	mun-chin-na	*nganja-rna* 'to love, like'
102.	kicking	tukka-manna	*daka-rna* 'to pierce, poke, kick'
103.	kill	tunderra-anna	*dandrra-rna* (*cf.* 81)
104.	licking	tunya-anna	(Wangkangurru cognate)
105.	lazy	mumma-anna	*ngama-rna* 'to sit'
106.	lake	wurra-li*	

* Hercus points out that *Warrha(nha)* is the name of an important freshwater lake near Poeppel's Corner. It is possible that the speaker(s) consulted by Wells named the best-known lake of the general area.

	English	Native	Ngamini
107.	long time	minna-minna	*minha* 'what, something'**
108.	leaves	thalpoo	*tharpa* (*cf.* Diyari *tharlpa*)
109.	lips	pim-ma	(Wangkangurru cognate)
110.	lizard	kad-ni	*kani* 'sleepy lizard'
111.	louse	pir-di	
112.	long nose	mood-la	*mulha* 'nose' (*cf.* 90)
113.	lightning	mil-yar-roo	*milyaru* 'dark, night' (*cf.* 38)
114.	liver	kull-yoo	*kalyu*
115.	look out	nil-kan-nā	*nhirrka-rna* 'to look, see' (*cf.* Yarluyandi *nhika-rnda*)
116.	long way	warrā-tā	*warrhatha*
117.	laugh	kunkă-annā	*kingka-rna*
118.	man	kalkă-arroo	*karrkarrhu* 'old man'
119.	me	mun-yi	*nganyi* 'I'
120.	mouth	pimā-mā	(Wangkangurru cognate, *cf.* 109)
121.	moon	perā	*pira*
122.	mosquito	koon-ti	*kunthi*
123.	mother	mundri	*ngandrri*
124.	mob	wit-tā	*wita* 'many' (*cf.* 67)
125.	moths	mi-attā	*mayatha* 'boss'
126.	mopoke	munkă-noo	
127.	mussel	koo-ri	*kurri*
128.	neck	oon-koo	*ngunku*
129.	nails	nirri	(Yarluyandi *nhirrhi*, *cf.* Ngamini, Diyari *pirrhi*)
130.	navel	pin-tā	*pirda*
131.	nose	mood-lā	*mulha* (*cf.* 112, 90)
132.	nostril	moodlā-wirripā	*mulha wirpa* (*cf.* 90)
133.	no	wo-bā	*wapa* 'go-imperative'
134.	no good	mun-nā	*manha*
135.	one	oon-warrā	*ngunharra*
136.	old man	kulkă-aroo	*karrkarrhu* (*cf.* 118)
137.	old woman	widlă-prinnă	*wilhapirna*
138.	parrot	kundră-ungoo	
139.	penis	oon-too	(Wangkangurru cognate)
140.	pigeon	wappăroo	*waparu* 'flock pigeon'
141.	pelican	tum-pung-ărrā	*thampangarrha*
142.	pouch (pelican)	war-roorā	
143.	quart pot	walpa-ittā	
144.	run	pool-kanna	*parka-rna* (*cf.* Diyari *parlka-rna* 'to travel')
145.	rat	mi-aroo	*mayarrhu*
146.	red ochre	kal-koo	*karrku*
147.	rump	u-rā	(Wangkangurru cognate)
148.	sister	kar-koo	*kaku* 'elder sister'
149.	sneezing	kootoo kootoo-gudda	
150.	stone	mud-dā	*marda*
151.	sand	dar-koo	*daku* 'sandhill'
152.	sandhills	dar-koo	*daku* (*cf.* 151)
153.	salt	that-too	*thaltu* 'salt' (loan from English)
154.	sleep	pur-rinna	*purrhi-rna* 'to lie, sleep'
155.	stomach	toon-droo	*thundrru*
156.	sore	minkie	
157.	string	urip-ā	*yurupa* 'rope' (loan from English)
158.	scratching	mirrā chuntā	*mirrha-janda* 'scatch oneself' (participial of *mirrha-jarrhi–*)
159.	sun	kul-ka	*kalka* 'sunset'
160.	sundown	ditchi-wirrina	*diji wirrhi-rna* (lit. 'sun enters')
161.	spear	wadna-quin	*wanakuyu*
162.	smoke	tuppa-inna	*thapa-rna* 'to drink, suck' possibly used for 'smoke (a pipe)'
163.	stick	prit-ta	*pirta* (*cf.* 21)
164.	shadow	mil-poo-ooroo	
165.	sky	mily-ya-ooroo	*milyaru* 'dark, night' (*cf.* 113, 38)

** Hercus also notes that Yarluyandi and Eastern Wangkangurru have a word *minyiminyi* which is used to describe a very old woman, the oldest person in any group.

	English	Native	Ngamini
166.	shoulders	winka-arrie	
167.	snake	tip-pă	*thipa*
168.	"venomous	tundri-prilla	*thandipila* (*cf.* Diyari, Yarluyandi *thandrripila*)
169.	spitting	kuntha-urnā	
170.	sit down	mammă-na	*ngama-rna* (*cf.* 105)
171.	stand up	tulkalla-tunda	*tharrka-rna*
172.	sick	wi-wi	
173.	snoring	mundoo-rainā	(Wangkangurru cognate)
174.	shield	murrā-numma	
175.	skin	kul-tā	*karla*
176.	shame	munthă-unnoo	*muntha-nu* 'shame-ergative'
177.	sweat	kung-oo	*kangu*
178.	spider	mutta-nā	*matha-rna* 'to bite' (*cf.* 8)
179.	small	koo poo-ta	*kupa* 'child'
180.	stink	toon-kā	*thungka*
181.	suck	tup-pannā	*thapa-rna*
182.	swimming	turra-gunna	*tharrhaka-rna*
183.	sunrise	moo-yoo-untā	(Wangkangurru cognate)
184.	scalp	wil-kā	
185.	two	par-koo-oona	*parrkuna*
186.	three	parkoo-oona-oona	*parrkuna ngunha* (lit. 'two one')
187.	teeth	munna-deerie	*marnathirri*
188.	thighs	wil-yi-ri	*wilyirri* 'buttocks'
189.	teats	mummā-brinnā	*ngama pirna* 'big breast'
190.	testicles	damp-oo	*dampu*
191.	tickling	kicherie poo-doo poodoo	
192.	toes	tidna-nulki	*thina* 'foot'
193.	tail	kid-ni	*kini*
194.	thunder	mik-arrie	*mikiri* 'desert well'
195.	thirsty	won-koola	*wangku-lha* 'nothing-now' (*cf.* 69)
196.	tattoo mark	mundri	
197.	throw	warrinā	*warra-rna*
198.	tall	warrā li	
199.	tomahawk	kommi-yakoo	*kamiyaku*
200.	you	in-ni	*yini*
201.	you walk	wop pinna	*wapa-rna* 'to go, walk'
202.	yawn	yuk-ki-yi	*yakayayi* 'goodness me!'
203.	yes, I know	pe-pe	(Wangkangurru cognate)
204.	uncle	kuk-kā	*kaka* 'mother's brother'
205.	vagina	milyi	*milyi*
206.	veins	u-ree	*yuri*
207.	water	nap-pā	*ngapa*
208.	wood	thal-poo	*tharpa* 'leaf' (*cf.* Wangkangurru *jalpa 'wood'*)
209.	wrist	oon-nā	*nguna*
210.	whistle	wil-prinnā	*wirpa-rna* (*cf.* Diyari *wirlpa-rna*)
211.	whirlwind	wom-meria	*wamara*
212.	womb	kulyi-erra	(Wangkangurru cognate)
213.	windpipe	ulkoo-anna	*ngalka-rna* 'to swallow'?
214.	wet	kuna-oo	*kangu* 'sweat' (*cf.* 177)
215.	woman (married)	willa-prinna	*wihapirna* 'old woman' (*cf.* 137)
216.	white	wil-ye-u	
217.	whip	takoo-ippa	(*cf.* Wangkangurru *thaku wipa* 'stock whip', loan from English)

Schoknecht's Data

Carl Schoknecht was a missionary to the Diyari at Killalpaninna from 1871 to 1873. In the introduction to his translation of Schoknecht's dictionary, his grandson J. C. Schoknecht (1947) provides the following information, from a small note-book kept by the missionary:

> Karanura. Location: Same as No. 7
> Examples of the language: wirta, spear; pinawila, boomerang; mara, hand; kapa, water; wanda, vegetable food.

The annotation 'Same as No. 7' means that the location was recorded as being the same as the 'Wonkamala' tribe, namely 'A creek to the east of the Salt Creek (kalakupa)'.

We can recognise some of these words recorded by Schoknecht, and compare them with the forms given by Wells and their Ngamini cognates:

Schoknecht	Wells	Ngamini	Gloss
wirta	–	*wita*	'spear'
pinawila	–	*kirra*	'boomerang'
mara	murrā	*mara*	'hand'
kapa	nap-pā	*ngapa*	'water'
wanda	–	*yutha*	'vegetable food'

Reuther's Data

There are a few words of Karangura scattered throughout the early pages of Reuther's massive Diyari dictionary (Reuther 1981), mostly in the form of comparative notes on neighbouring languages. The forms which appear are listed below, together with notes on them and comparison with Ngamini:

1. Under the Diyari entry *dama-* 'to cut', Reuther lists the Karangura cognate as 'dramatjanta'. We can compare this to the Ngamini verb *damajanda*, which is the reflexive participial form of the verb *damajarrhi-* 'to cut oneself'. Notice that Reuther's Karangura form shows the same reflexive participial inflection as in Ngamini and also the same as we noticed in Wells' vocabulary (see above). The initial 'dr' in the verb given by Reuther is unexpected. Wells' item 23 has 'cutting' – 'dum-an-nā' (*dama-rna* as in Ngamini and Diyari). Now, there is a regular correspondence whereby words with initial *.d* in Diyari-Ngamini have cognates with *drr* in Yandrruwandha-Yawarrawarrka, as the following forms illustrate (see also Austin 1988):

Dyari	Ngamini	Yandrruwandha	Gloss
dama-	*dama-*	*drrama-*	'to cut'
daka-	*daka-*	*drraka-*	'to pierce'
danga-	*danga-*	*drranga-*	'to hunt away'
diji	*diji*	*drriji*	'sun'

Immediately preceding the Karangura entry 'dramatjanda' in Reuther's dictionary is the Yawarrawarrka cognate 'dramajandrari' *(drrama-yindrra-ri):* it is possible that he copied the initial 'dr' onto the Karangura word by mistake.

2. Under the Diyari entry for *kurda-* 'to fall' (of rain), Reuther lists the Karangura word 'burndatja' (and also the Ngamini word 'burina'). We can recognise this as the normal verb 'to fall' *purrhi-* in its participial form, namely *punda*. As noted in relation to Wells' vocabulary, Ngamini verbs have a number of participial forms, and those verbs ending in *rrhi-* add *nda* to form the participial (deleting the final syllable). Again, we have strong evidence that Karangura was grammatically identical to Ngamini in this respect.

3. Under the Diyari entry *kaldrri* 'salty', Reuther gives as Karangura the word 'kalikalitja' (as distinct from Ngamini 'kaldrikaldri'). I have no comments on this form.

4. Under the Diyari entry *kalkawarrha* 'evening', Reuther has Karangura 'kalkauratja' (and Ngamini 'kalkaura'). Again, we have a form identical to both Ngamini and Diyari. The final 'tja' may be some kind of emphatic suffix, as in the previous two examples.

These are the only instances of Karangura words in Reuther's work.

Conclusion

The vocabulary in Wells' 1894 paper is an invaluable source on the Karangura language. For most of the entries in it we are able to recognise their cognate forms in the neighbouring languages. Lexical and grammatical hints in Wells' list suggest that Karangura was very closely related to Ngamini and that it was therefore located in the eastern Lake Eyre group of languages, along with Yarluyandi, Diyari and Thirrari. Wells' data is confirmed by other fragments to be found in the writings of Schoknecht and Reuther.

We have good evidence from Hercus' research that the Karangura possessed ceremonial and mythological links with the Wangkangurru people. While the Karangura vocabulary shows a high degree of cognacy with Ngamini, there are also quite a number of cognates with Wangkangurru, reflecting an areal vocabulary (also partly shared with Thirrari). There is additionally some evidence of grammatical features shared with Wangkangurru, primarily the short participial forms of certain verbs ending in *i*. This characteristic is an areal feature of Wangkangurru, Ngamini and Karangura.

Finally, our research has demonstrated the importance of considering historical linguistic documents in their areal and comparative context, making use of all that we know from both historical and contemporary sources.

Acknowledgments

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the Australian National University. Luise Hercus assisted with obtaining a copy of Wells' vocabulary list and Reuther's vocabularies, and provided comparative data on Wangkangurru; she also gave valuable comments on an earlier draft of this paper.

Endnotes

1. Ngamini data come from: my field notes and tape recordings, my transcriptions of Gavan Breen's tape recordings, and a 'Ngaumeni' comparative vocabulary collected by J. G. Reuther. The orthography used for Ngamini and other eastern Lake Eyre languages is the same as that employed in Austin (1986) and all publications on Diyari thereafter. The spelling generally follows Australianist practical orthography conventions: *th nh lh* are lamino-dentals, *j ny ly* are lamino-palatals, *rd rt rn rl* are apico-domals (retroflex), and *ng* is the dorso-velar nasal. Note that all the languages have three 'r-sounds': *r* a retroflex continuant, *rr* an alveolar tap, and *rrh* an alveolar trill. The vowels are *a i u*.

2. In all the eastern Lake Eyre languages the ergative case is used with abstract nouns and a copula verb to predicate a psychological state of the subject (see Austin 1981: 121), as in Ngamini *nganyi muwa-nu ngana-yi* (I hunger-erg be-present) 'I am hungry'.

3. Thirrari became extinct early this century, although I was able to collect a little information on it from Ben Murray who learned the language as a child from his maternal grandmother [see Austin (1981: 4ff), Austin *et al.* (1988)]. Ben Murray's Thirrari is almost identical in vocabulary to Diyari (apart from a couple of unique lexical items such as *kurdingka-* 'to run', *cf.* Diyari *mindrri-*, and *dandrra-* 'to hit', *cf.* Diyari *nandrra-*) though there are some differences in the form of affixes, particularly the verb suffixes. The Thirrari recorded by Reuther shows exactly these differences in affixes, but additionally has a number of different vocabulary items which are not the same as the Diyari words (but which *are* identical to the corresponding Wangkangurru words). It may be that the last generation of Thirrari speakers had adjusted their speech towards that of their more numerous Diyari neighbours.

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GLIMPSES OF THE KARANGURA

LUISE HERCUS

HERCUS, L. 1991. Glimpses of the Karangura. *Rec. S. Aust. Mus.* **25**(2): 139–159.

Karangura people occupied lower Eyre Creek in the far north-east of South Australia. They had disappeared by early this century. This paper seeks out some of the causes of this tragedy, and records what has been preserved of Karangura traditions by the neighbouring Wangkangurru and Yarluyandi people.

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It is one of the many tragedies of Aboriginal people that their traditions have not been treated with general respect until relatively recently, when for vast tracts of the country it was already too late. Even this belated recognition lacks egality: it is often said that Aboriginal traditions only have significance when the groups to whom they belong still have knowledge and attachment to them. This attitude is inevitably compounded by land-rights legislation which by its nature has to deal with the claims of living people. There are no such restraints militating against European and Asian traditions. It is unlikely that anyone would claim we should forget all about the Sumerians because nobody now has any direct links to them and because a lot of what we know about them was written down by Babylonians anyway. Traditions, whether they are ancient Sumerian, recent European or Aboriginal all have significance as being part of human thought.

It is a sad fact that many of the groups that once inhabited south-eastern Australia are now known by little more than names on a tribal map. The same applies even to people who once lived in more desolate parts of Central Australia: there are groups that became extinct early this century. A typically tragic case is that of the Karangura people of what is locally called the lower Georgina – the Eyre Creek of modern maps and the Herbert River of early maps.

Though they have no modern descendants, Karangura people should not be regarded as irrelevant and their traditions deserve recognition – provided we can at least get a glimpse of them.

There are two possible sources of knowledge of Karangura country and Karangura people: these are meagre historical and ethnographic documents from last century on the one hand, and what oral evidence could be gathered over the last two decades from the oldest of their surviving neighbours, people of Wangkangurru and Yarluyandi descent. The actual text of this oral evidence is given where relevant here: some of it is in English, some in the Wangkangurru language.

Karangura Country

There is some measure of agreement as to the general location of Karangura country (Figs 1 and 2). Howitt in his papers (n.d., paper 5), when discussing whether a Diyari person could eat whichever animal was his matrilineal descent totem, mentions the location of the Karangura in relation to the Diyari: 'further to the north among the Karangura, Marunga and Yudlayudlanga *etc.* the mardu is not eaten'. In his map (1904: 44), based mainly on evidence gathered by him decades before, Howitt shows the Karangura as living along Eyre Creek.

Tindale (1974: 212) has the following entry:

Loc.:	South of Alton Downs on Eyre Creek; east to Pandi Pandi; on the Eleanor River south to the northern margin of Goyder Lagoon. Wells listed fourteen named hordes.
Coord.:	138°40′E × 26°25′S
Area:	3 200 sq. m (8 300 sq. km)
Alt.:	Karangura, Karangura, Kurangooroo, Andrawilla (native name of early police camp, now Andrewilla).

More recent evidence obtained from neighbouring people confirms this general location. The most senior Wangkangurru man, Mick McLean, speaking to Luise Hercus in January 1967 (Tape 66) about the Seven Sisters Myth and Song Cycle, described how the Old Man *Unthuriya*, sometimes also known as 'the Larrikin Man' went with Seven Sisters:

Text 1. Seven Sisters

M.: Take'm down Cooper's Creek and to the Diamantina then. *Thita-purrunha* 'Full of Ants', that is Karangura country, Karangura and Wangkamadla mixed, Adria Downs.
Then further is *Ngurrawani*, (Gnarrowie Well) straight down from Adria Downs.
L.: Nallamundie Waterhole, is that Karangura?
M.: That is all Karangura. *Thitirri*, supposed to have been straight down from Adria Downs.
They (the Seven Sisters) followed the creek right down, they come up half way up in that creek and cross over where the Kallakoopah starts. That's where they start to dance . . .

This account mentions the northern part of the area given by Tindale, and includes Adria Downs, slightly further north still than Alton Downs. Other

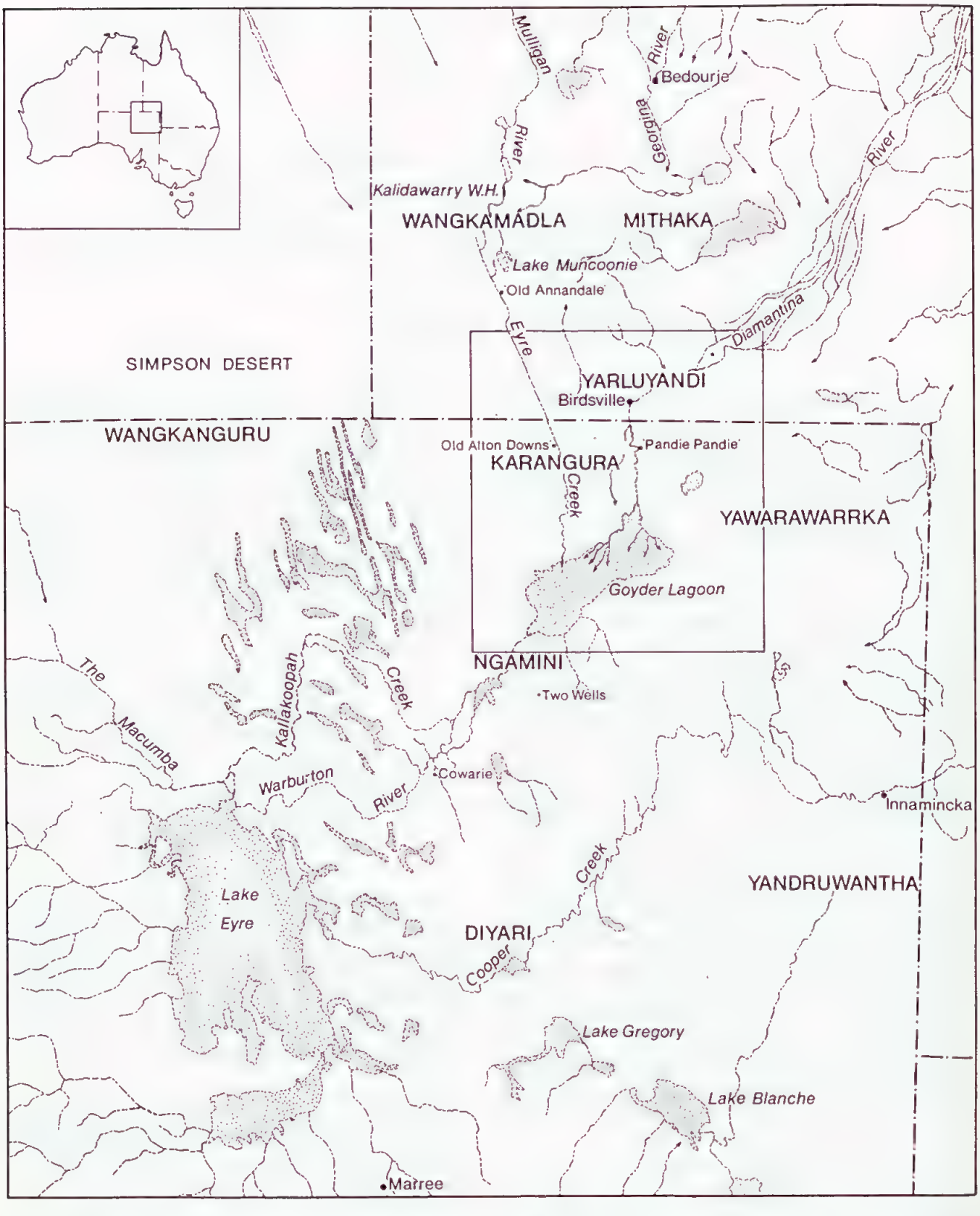

FIGURE 1. North-east South Australia and south-west Queensland, showing major Aboriginal groups at the time of European contact. V. Potezny, 1991.

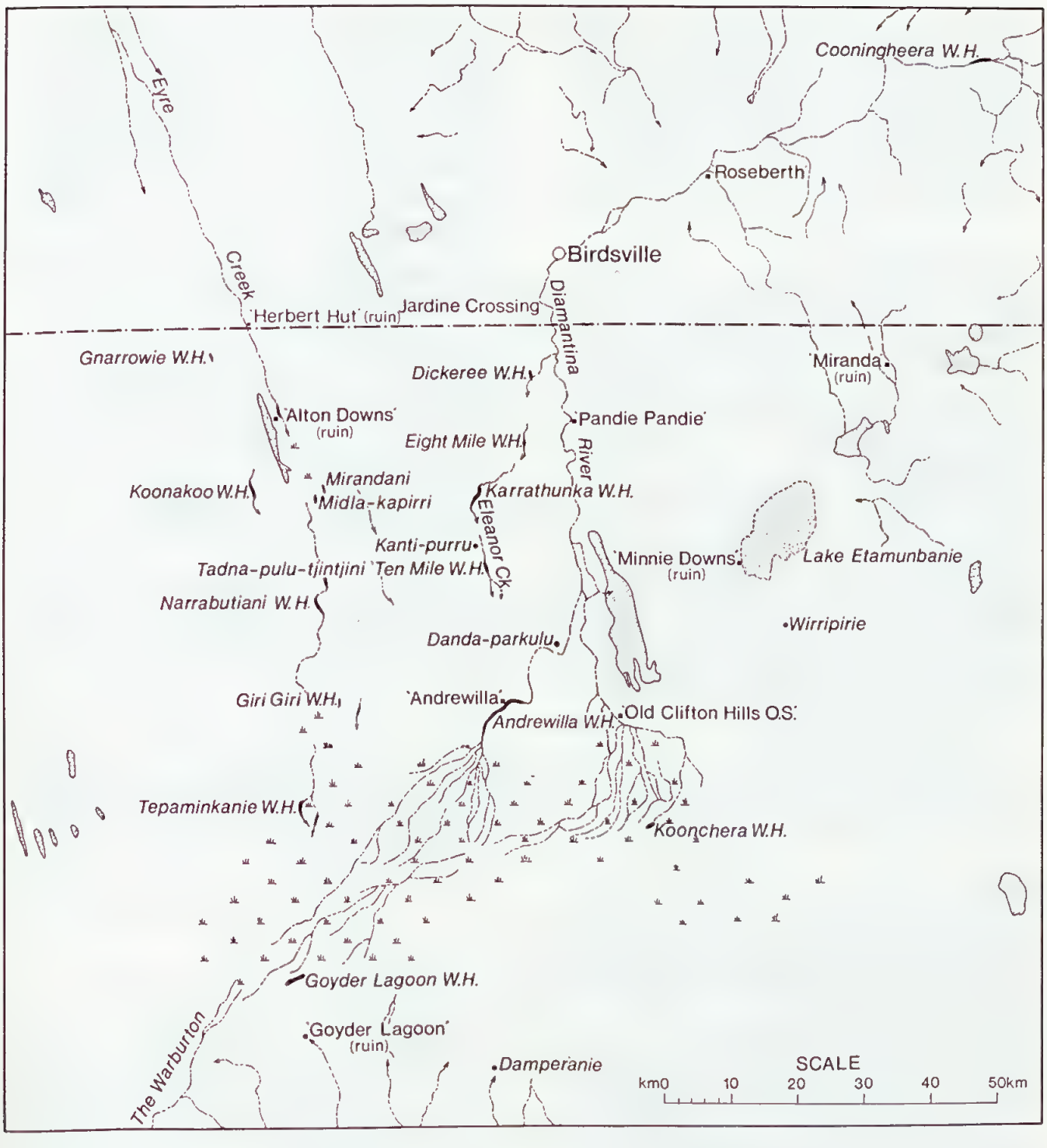

FIGURE 2. Important sites in Karangura and neighbouring country. V. Potezny, 1991.

mythological accounts, discussed below, and also identical statements made in 1974 by Maudie Naylon of Birdsville (born *ca* 1886) further corroborate Tindale's general positioning of Karangura country. One important point to note is that there is general agreement: only the western, the Eleanor channel of the Diamantina traditionally belonged to Karangura. The eastern channel belonged to Yarluyandi people and to Ngamini people further south near Goyder's Lagoon, with Yawarawarrka people coming in from the east.

Northerly Neighbours

There is one major disagreement between Tindale and the evidence gathered from people over recent years – admittedly much younger than his informants. This disagreement concerns the position of Yarluyandi country: according to Tindale Yarluyandi people were the only immediate northerly neighbours of the Karangura. The recent evidence, supported by the myths, indicates that Yarluyandi country was situated along the Diamantina and not Eyre Creek. It was the

Wangkamadla, the south-westernmost of the Pitta-Pitta group, who in traditional times lived around Annandale and extended down towards *Thita-purru* ('Full of Ants'), Adria Downs. Adria Downs was repeatedly said to be 'both Karangura and Wangkamadla mixed'.

There is an account of events in the Adria Downs country late last century, in the nineties, when a small group of Wangkangurru people arrived there, on their way out of the desert. It is evident from the account that Karangura people were no longer there. Their neighbours, the Wangkamadla people from Annandale however were still in the area and took a poor view of this visit, which unlike expeditions for pituri, was unplanned. This was described by the Wangkangurru speaker Mick McLean Irinjili who had heard about it subsequently (tape 571, 1971):

Text 2. Adria Downs

1. M.: Adria Down is what they call *Thita-purru*, whitefellow call'm . . . there is swamp, *kutha nganthu*. That is where they could be *ngurku*, plenty *paya, paya papu.*
2. *Pinja-ru paliji-rna-pirda-lhuku, uta kari-nha kaparra.*
   War-party-ERG strike-SP-kill-HIST, now they-ACC blood-feud.
3. *Kari-nha partjarna anthunha mapu kumpira-ma-ru* from Annandale, our mob *Wangk' aranda-kunha arluwa*
   They-ACC all my mob dead-make-NAR Speech-Aranda-POS child
   partjarna pirda-lhuku.
   all hit-HIST.
4. *Kumpira-ma-lhuku kari-kunha watji-nangka-ngura ngata-ki ngata-ngata-ki, maljka nguyu*
   Dead-make-HIST they-POS follow-CONT S-CONT after-EMPH after-after-EMPH, not one
   thangka-nha.
   sit-NP.
5. Johnnie Reese-kunha anja, he is one of them but he has gone. Pandi Pandi. He was pinja-nga join in. His brother got killed.
6. *Uka-kunha nhuthi mudlu-nga kayirra uka-kunha nhuthi idni-ngura* Birdsville, you know
   He-POS brother sandhill-LOC there he-POS brother lie-CONT
   mudlu-mudlu? There *uka-kunha nhuthi, Parraka-nhanhi,* old *Njurrili* ha!
   sandhill-sandhill he-POS brother, Bank-see
7. That pinja is no good, I don't like 'm.
   L.: *Kari-ri partjarna pirdayi-ka?*
   They-ERG all kill-PAST?
8. M.: *Ngata-ngata-ki* clean'm up; *partjarna, mankarra njurdu pirda-rnanha mankarra-kari-nha, kayirra thangka-ka*
   Later-later-EMPH all, girl too kill-IMM girl-PI-ACC, there sit-PAST
   anthunha kaku, Finke Bob been have'm, she was the last, *uka nguyu-ki tharka-rna.*
   my sister, she one-EMPH stand-IMP.

Text 2. Translation

1. 'Adria Downs' is the name that whitefellows call *Thita-purru* 'Full of Ants'. A swamp is there with water laying about in crab-holes. This was a place where they would be fine, there were lots of birds and eggs.
2. A war-party came to attack and kill them, and now they had a blood-feud.
3. Those Annandale men killed all those people there who were from my mob, they attacked our mob who had (some) Aranda-speaking parents.
4. They killed them and persecuted them later on and then later on again, so that not one should stay alive.
5. Johnnie Reese's father was one of (the group who were being pursued) but he had gone, he was at Pandi. He joined in (a reverse) war party. His brother got killed.
6. His brother is (buried) there on the sandhill, his brother was staying at Birdsville, you know that little sandhill, that is where his brother is (buried), that was *Parraka-nhanhi* 'Looking at a steep bank', they also called him old *Njurrili*, oh!
7. Those war-parties are no good, I don't like them.
   L. Did they kill everybody?
8. Later on (the Annandale men) killed the whole lot (of this small group), the girls too, but my (classificatory) sister stayed alive, the one that Finke Bob married, she was the only one left.

Ultimately the feud was abandoned, the revenge killings stopped, and early this century Wangkangurru people actually went to join the Wangkamadla group at Annandale. This was recalled by oral tradition and is proved by a letter sent from Annandale to the Office of the Chief Protector of Aboriginals in Brisbane in 1908 (a copy was made available to the author by Angus Green). It gives a list of 43 people with the comment: 'the above consist of Blacks mustered here on the 10th Oct 1908.' Many of the names on the list are English and nondescript, such as 'Judy', 'Biddy' and 'Jubilee'; some are clearly Wangkamadla like 'Muncoonie Jack' and 'Mulligan Mick', but at least a few are known to have been Wangkangurru, such as 'Yarotilli' (*i.e.* Yaratuli) and 'Pigweed', who was really Jessie *Miljawitjinangkarda,* and one, Lucy Kingkardie (*i.e. Kingkardi* 'Laughing') was Yarluyandi. The place-names along the Eyre Creek north of Adria Downs

corroborate the evidence that before this influx the Annandale area was not Wangkangurru nor Yarluyandi but Wangkamadla country. The Annandale group of Wangkamadla people was well known to the oldest people of part-Yarluyandi descent at Birdsville who regarded them as outsiders but had extensive information about them. They could still point out a site called *Nganawardani* where two small creeks come out of the main channel on the western bank of the Diamantina on the Queensland-South Australian border: 'we used to have the big (*Warrthampa*) corrobories at *Ngalpura-ngura*, Jardine Crossing, just up a bit. Different people came from everywhere, and the Annandale mob camped here at *Nganawardani*.' They made it clear that the bulk of the Annadale people were not of 'our (Yarluyandi) mob': they were Wangkamadla, not Yarluyandi. In his large-scale study in south-west Queensland, working mainly with Pitta-pitta people, Breen came to an identical conclusion. As his map shows (Breen 1971: 21), the Wangkamadla were traditionally the immediate northerly neighbours of the Karangura.

The fact that Wangkamadla people were their immediate northerly neighbours had some importance for the history of Karangura people. As Austin demonstrates (1991), the Karangura belonged to the Diyari language group like their southern and eastern neighbours, the Ngamini and Yarluyandi. They were in fact the most north-westerly outpost of this group and had as less related neighbours the Wangkangurru people in the desert on the west, and the Wangkamadla people further up along Eyre Creek to the north. The Karangura were thus on the cross-roads between a number of traditions, which put them into a vulnerable position once the old order broke down.

Karangura People: A Small Tribe

Apart from the waterholes on the Eleanor in the Andrewilla area, the main country of the Karangura was along the 'Georgina', the lower Eyre Creek. Unlike the Diamantina, this creek floods only rarely: the water of the upper Eyre Creek and the Mulligan has to fill Lake Muncoonie to the north and then be high enough to back out again before it can flow down the Georgina channels. This is not, and was not, hospitable country: when the waterholes in the Georgina channels dried out the Karangura depended on soaks and some wells in the adjacent sandhill country or had to congregate by the longest-lasting Eleanor waters. They could manage this because they were a small group. Birdsell (1973: 344) made calculations intended to show that theoretically even at the time of contact the 'Karanjuru' might have consisted of as few as 32 persons. They were the very smallest of the small tribes living in an area where there was an easterly expansion of the subincision boundary. Birdsell concludes that this expansion led to a fragmentation of tribes. There is evidence, not only from Wells (1894: 515) of the existence of a number of local groups of Karangura. A population count as low as 32 is therefore highly unlikely for the time of first contact. Nevertheless the ecological evidence indicates that Birdsell was justified in thinking that the Karangura must have been amongst the smallest tribes, and may indeed have numbered only around 100 when the Europeans arrived.

Karangura People: Earliest References

The information about Karangura country may be clear in its outlines, but we know little about the people. J. W. Lewis's exploration party crossed Karangura country in February 1875 (Threadgill 1922: 165), but his map does not contain a single Karangura place-name. The surveyor Cornish worked in the area in 1880. His map was recently acquired by the Mortlock Library and was found there by V. Potezny. It shows a number of Karangura waterholes, 'Kooringala', 'Tooracky', 'Kalkaparidiginna', and 'Koonakoo'; but he does not mention the people he must have met (Fig. 3). The earliest published mention of the Karangura is by W. J. Paull in his introduction to the 'Ominee' (Ngamini) vocabulary (Paull 1886: 18). He states that:

> The marches of the lands of the Ominee, Wongonooroo, Kuranyooroo and Yarleeyandee tribes, all intimately connected, meet on the Warburton River at Cowarie head-station.

Cowarie was in Ngamini country, but there is plenty of oral traditional evidence to show that under the impact of white settlement people from adjoining groups congregated here.

The most informative early reference to Karangura people is by the police officer F. H. Wells in his article on 'The Habits, Customs and Ceremonies of the Aboriginals on the Diamantina, Herbert and Eleanor Rivers, in East Central Australia'. He starts by saying:

> The natives of the localities named belong to the Andrawilla tribe, and occupy a block of country about ninety by ninety miles. The chief tribe is subdivided into smaller tribes or clans *viz:* Andrawilla, Kuntapunchinna, Dickeri, Kyratonka, Kertie-terie, Yumalla, Kerra, Dipracoolie, Tunbulla, Koringurra, Kalkaparichinna, Mundowalla, Tippaminkinna and Dampaminnie; these tribal names being taken from the names of various waterholes in the locality inhabited by the tribe, such as Andrawilla, Kyratonka *etc.* (Wells 1894: 515).

These names do indeed correspond to names of waterholes, Most are known from three other sources besides the list given by Wells: 1. from the unpublished map produced by Hillier in 1904 according to the data of Pastor Reuther at Killalpannina mission, 2. from the more recent evidence of Aboriginal people of Wangkangurru and Yarluyandi descent, 3. from modern maps. The correspondences between Wells's list and the other sources is illustrated in Table 1. The recent Aboriginal information is given in italics.

'Koringurra', which is mentioned in the Well's list, is probably the actual tribal name Karangura, but we cannot rule out the possibility that it might be Kooringala waterhole on Eyre Creek, called *Kuringala* 'Whitewood tree' by recent speakers of Yarluyandi and Wangkangurru.

With the possible exception of this tribal name, the items on this list are all names of major waterholes, and there can be little doubt that they were centres of small local groups. Most, but not all of them, were no doubt originally Karangura centres. The Andrewilla waterhole (Fig. 4) appears to have belonged originally to Karangura people, as did the area towards the south to Goyder's Lagoon. Two of the waterholes listed by Wells are however some considerable distance outside the area: Damperanie and 'Miranda' are situated to the south-east and east in what was probably Yawarawarrka country, while 'Kuntapunchinna', Pandi Pandi, was to the north and Yarluyandi people consider it part of their original territory. It might have been a place shared by Yarluyandi and Karangura people.

Wells obtained his information at Andrewilla in the early 1890s. He writes of the 'Andrawilla tribe', but he is obviously referring to whoever happened to be living at Andrawilla at that time. He did not differentiate between the various groups, though his vocabulary must have come from Karangura people. Wells gives us further important information in that he mentions some names of persons of the 'Andrawilla tribe'. Some of these names refer to people who are known from other sources; one survived till recently, while others have relatives who recall them. They were people from various groups from the north-east of South Australia, who happened to be at Andrewilla. Only a few were Karangura, even in 1892–3:

FIGURE 3. Individuals of the 'Andrewilla Tribe', photographed at the Andrewilla Police Camp during the 1890s. State Records, South Australia, GRG.52.

TABLE 1. Localities of the 'Andrawilla Tribe'.

Wells's name	Name on modern map	Aboriginal name Reuther		recent
Andrawilla	Andrewilla	Nganarawirli	Y.	*Nganarawirli*
Kuntapunchinna	Pandie Pandie	(Pandi Pandi)		*Kanti-pantjini*
Dickeri	Dickeree, also Alton Downs Waterhole	Dikiri	Y.	*Dikirri* *Dikirri*
Kyratonka	Karathunka	Kayiridunka	D	*Kayarathungka*
Kertie-terie	Annandale	Katijerra	Y.	*Katitharri*
Yumalla	Old Clifton Hills Outstation?	Jamarkirra?	Y.	*Yabmalkira ?*
Kerra	Giri Giri	Kiri-kiri	W.	*Kiri-kiri*
Dipracoolie	Old Lagoon	Tirpakurli	N.	*Thirpa-kurli*
Tunbulla	Toondooloo, 'Miranda'			*Thunpulu*
Kalkaparichinna	Kalkaparidiginna	Kalkapurutjini	Y.	*Kalkapuritjinha*
Mundowalla		Mandurali	Y.	*Mandawarli*
Tippaminkinna	Tepaminkanie	Tipaminka	Y.	*Thipamingkani*
Dampaminnie	Damperanie	Danpara	N.	*Danparani*

(Y. indicates that Reuther lists this place as being Yarluyandi, N. as Ngamini, W. as Wangkangurru and D. as Diyari).

FIGURE 4. Andrewilla waterhole, the largest in Karangura country. Photograph: L. A. Hercus.

Personal names listed by Wells

Male names

Kooripipinna – *Kuripipinha* was a Karangura man from Alton Downs. He was named after some special fossil bones which had magical qualities.

Appakulta – *Ngapa-kalta* 'Water-skin' could be a Karangura, Yarluyandi or Ngamini name.

Toondroo-wonko-inna – Probably represents a Wangkangurru name, *Thurndu wankayinha* 'Stomach Growing Big'.

Wadoo-woka – *Wardu-waka* 'Little short fellow' could be either a Diyari or possibly a Karangura name.

Watti-wattina – *Wati-watinha* 'Track' was a Yarluyandi man. He was the great-uncle of the Naylon family and brother to the last full Yarluyandi woman, Judy Trew *Thandripilinha*.

Tring-alli – *Thiringili* 'Sandy' was a Yarluyandi man who died at an advanced age at the Yelpawarilinna waterhole on the Diamantina in the early thirties.

Watti-kattana – *Wati-katali* was known to the oldest Yarluyandi people from their youth. He was a Karangura man and came from and also died at Alton Downs.

Oooroo-charoo – Wangkangurru *tjaru* means light cloud. This name probably is *Nguru-tjaru*, 'another white cloud'.

Female names

Paroo-moogunna – 'after a fish'. *Parru-mukunha* 'Bones of Black Bream' is remembered to this day. She was a relative of the Crombie family and was Yarluyandi. She spent most of her later life in the company of another Yarluyandi woman of the Fish totem, Polly *WaRi-WaRi* 'Yellow-belly'.

Nooyoo-nackaroo – 'after a fire' is probably the Wangkangurru name *Nguyu-Makaru* 'By one Fire'.

Akka-willi-likka – 'after a fire' is Maudie Naylon *Akawiljika*, of mainly Wangkangurru descent, who was born in the Simpson Desert about 1885 and died at Birdsville in 1980. Her name is Aranda, given by her part-Aranda father Bille Reese *Ngaltja-kintarda*. She was not only unique in her traditional knowledge, but she also happened to be at Andrewilla every time any known investigator went there. She was listed not only by Wells (1894), but also by Basedow (1919) and by Tindale (1934). In her later years she stayed in Birdsville. Her knowledge was representative of the mixed group of people who were at Andrewilla, and she maintained her attachment to traditions. Though her main language was Wangkangurru, she also had a command of Yarluyandi which she recorded for the author, and Ngamini and Yawarawarrka, which she recorded for Gavan Breen. There was also a man of this name, 'Akka-willi-likka' who was photographed at Andrewilla during the 1890s as one of a group of Wangkangurru arrivals from the Simpson Desert (Jones 1991: 172).

Naruwa – *Njaruwa* 'Wren' was known only as a man's name; there were two people of that name, 'little (*i.e.* younger) *Njaruwa*' and 'Big *Njaruwa*'. The older *Njaruwa* would have been a baby at the time of Well's stay at Andrewilla, and this may account for the mistake in gender. He was great-uncle to the Lumpkin and McLean families.

Wilyerooroo-mun-nung-arrie – 'after wind' is almost certain to stand for *Wiljaruru-maningaru* 'taken away by the storm'. This is a Wangkangurru name.

Wumma – 'after a snake'. This name is *Wabma/Wama* 'Snake', a word common to all languages in the area. The name therefore does not give any indication of which group the person belonged to.

Kal-li-irri – Nothing known

Wooti-inna – This could be the Yarluyandi name *Wutjunha* 'the blind one', but that remains uncertain.

Yarraguninna – Probably a Wangkangurru name *Yarra-kudninha* 'Putting something down on hollowed-out ground.'

It is clear from the evidence of these names that as early as about 1892–3 a mixed group was living at Andrewilla, and that the majority was not Karangura.

Karangura People: Negative Evidence

After Wells there are only few first-hand references to the Karangura. Howitt & Siebert (1904: 106) and Howitt (1904) published the same myth, originally collected by Siebert, presumably during his time at Killalpannina in 1900–1. It is about the Two Men who introduce the circumcision knife, and it is entitled 'The Malku-malku-ulu, a legend of the Karanguru and Ngameni'. Howitt and Siebert's work does not have any further specific mention of Karangura people, but it represents the last reference to the Karangura on first-hand evidence.

Gason (1874: 1895) had not mentioned the Karangura, but this is not surprising as he was writing mainly about Diyari people. It is after the evidence of Wells, from 1894 onwards, that the Karangura are conspicuous by their absence from written records. Albert Helling wrote from Cowarie to Howitt in March, and again in April, 1899, to give him information on Aboriginal people in the area. His letters, preserved in the Howitt papers, make no mention of the Karangura. Speaking of the current situation at Goyder's Lagoon he says: 'the Blacks there

are Wonkaooras, Yowraworkas and Ahminys. The former tribe predominate.' (Howitt, n. d.).

The missionary Reuther in his vast work written at the turn of the century made only rare references to the Karangura. They are not named on the map that Hiller drew, using Reuther's materials. Of the 2468 place-names which Reuther lists for the north-east of South Australia (Reuther 1981: Vol. VII), there is not one attributed to the Karangura. Place-names in what was traditionally Karangura country, as shown in the list above, he ascribes mostly to Yarluyandi, and a few to Ngamini and Wangkangurru. Not a single one of the famous toas (Jones & Sutton 1986) is attributed by Reuther to the Karangura. The Karangura do not figure among the lists of personal names (Vol. VI). All other groups, even those that had greatly declined in numbers, such as the Pirlatapa, are named on the Hillier map, and toas and personal names are listed for them. Only the Karangura are absent.

Horne and Aiston (1924) make no mention of the Karangura, neither do Tindale's and Fry's notebooks from their 1934 Diamantina expedition. F. Fenner took part in the same expedition and his article (Fenner 1936), which includes a map, also makes no reference to the Karangura.

There was no conspiracy of silence; something was clearly amiss with the Karangura, and strangely enough, this was connected with Karangura traditions and myths. The following sections will give some details of what has come down to us of Karangura traditions and how these are connected with the destruction of Karangura people.

A Karangura Song

Only one brief text has come down to us verbatim in Karangura. It came through a Diyari speaker, Mary Dixon, who was born about 1884. Mary was the daughter of a greatly respected and knowledgeable Diyari man, *Mawili*, who gave much information to Aiston (Horne & Aiston 1924: 44). She came to Killalpaninna at the turn of the century as a young married woman. Being married she was not allowed to go to the school and spent much of her time with the older women. An old Karangura woman taught her how to sing a Karangura lullaby for her first baby. She never forgot this and sang it to Luise Hercus and Dora Parker in 1966:

Text 3. Karangura Lullaby

Tjalpapa-li tjalpa-li
Warra warra kali-ma

Dora Parker (Wangkangurru) then explained:
Ngatji-rna ngataru. Wakarra pirda-lhuku,
Look-IMP behind. Neck hit-PURP.
'He might sneak up and hit you in the back of the neck if you are not looking.'

Text 3. Translation

Mary's song:
Box-tree by box-tree
(Around) the side (around) the side looking

Dora Parker: She is looking behind (the trees), in case someone were to hit you in the back of the neck. Someone might sneak up and hit you in the back of the neck while you are not looking.

In this Karangura lullaby the mother assures her baby that she has looked behind every tree by a waterhole and that all is safe. Looking behind trees is the Aboriginal equivalent of looking under beds. The lullaby is tragic since all the caution of Karangura people was obviously in vain.

Fragments Of Karangura Mythology: Some Minor Myths

A. The Two Dogs

The knowledge of a number of minor myths had remained with people of Wangkangurru and Yarluyandi descent: they could still explain some of what was once Karangura country. A very localised and stereotyped myth, interesting only on account of its location, was that of the Two Dogs, told by Linda Crombie, January 1989:

Text 4. Two Dogs

1. *Karna-katjarranha* two dogs name that and there is the flat, big one too. You can go to the top of the Andrewilla sandhill and you see it. Make me sorry when I have a look at the country.

2. *Ularaka-nga madla-ru warrawa-rna warrukathi-pula-nha; puntha-li purda-lhuku*
   History-LOC dog-ERG chase-IMP emu-TWO-ACC; drink-HAB get-down-HIST
   puntha-li purda-lhuku
   drink-HAB get-down-HIST.

3. *Warrawa-rna* right up to *Karna-katjarra*, no, *Wipala-payirri, Walka-thipani*
   Chase-IMP
   madla-pula-ru. pirda-rna warrukathi pula-ru
   dog-two-ERG. kill-IMP emu two-ERG.

Text 4. Translation

1. *Karna-katjarranha* 'Clever Man' is named from the two dogs. It is a big flat area. You can go to the top of the Andrewilla sandhill and you see it. It makes me sorry when I have a look at the country.
2. In the history time the Dogs chased two emus there. The emus used to come and crouch to have a drink (at the Andrewilla waterhole).
3. The two dogs *Karna Katjarra*, 'the Clever Man', no (I mean) *Wipala-payirri* 'Wide Flat' and *Walka-thipani* killed the emus.

B. Kimili 'Kanti-purru' The Black Snake and Kurkari the Green Snake

Kimili, also known as *Kanti-purru* 'Carrying a waddy', is the main ancestor to whom Reuther attributed the naming of places along the Eleanor channel in what was traditionally Karangura country. Reuther regarded this as Yarluyandi ground; there must in any case have been close connections between the Karangura and the Yarluyandi who immediately adjoined this area. All the sites along the Eleanor are associated by him with *Kimili*, this includes for instance the main Andrewilla waterhole, the nearby *Karna-katjarra* sandhill of the story above (Vol. VII: 1475), *Ngampangampayarra* (Vol. VII: 1479) 'Eight Mile Waterhole', and *Tharnapulutjintji* (Vol. VII: 2044), 'Ten Mile Waterhole'. The only conspicuous exception is *Kajiridunka* Karathunka (Vol. VII: 828).

The Snakes and the Grinding Stones

There are several myths that related how people along the Eleanor and adjacent areas on the Diamantina did not have grinding stones of any kind and were trying to eat unground nardoo and grass-seeds. Then the two Snake Ancestors came from the north via Alton Downs. *Kimili*, the Black Snake, as well as carrying his waddy, came with a seed-grinding dish, while his companion *Kurkari*, the Green Snake, was carrying a *ngampa*, a nardoo stone. They separated near Old Alton Downs.

Kurkari with his nardoo stone came along the *Kutari* sandhill near Bayard's yard, to the east of Karathunka. He put down his stone and rested. *Kimili* joined him there and they camped. While they were asleep *Tjilpuru* the Bush-lark boy came sneaking up from the *Ngardu-mathani* 'Biting (unground) nardoo' sandhill by the Diamantina, which was Yarluyandi country. He was intending to steal the nardoo stone. The people at the Eight Mile Waterhole however were much closer; they called out *ngampa ngampa yarra*, 'a nardoo stone is over there, quite close!' Hence Eight Mile Waterhole has the slightly abbreviated name *Ngampampa-yarra*. These people sneaked over to the sandhill, took the nardoo stone and went back to grind nardoo. In the morning the Man from the North caught up with them and retrieved his stone. It was very heavy and he managed to carry it to *Kayirri-thungka*, Karathunka. He put it down and rested, still in company with *Kimili*. Now it was *Tjilpuru*'s turn to steal the stone.

He crept up and took it away first to *Ngardu-pandiyarranha* 'Pounding Nardoo' waterhole just north of Manganuni waterhole, where the grandmother was the first one to try it out. Then all the family went further south along the Diamantina with the stolen stone to their big camp at *Ngantji-malkani*. This is where *Tjilpuru*'s grandmother made a song about it in Yarluyandi:

Text 5. The Nardoo Stone Song

(The Grandmother's song, recorded by Maudie Naylon, Sept. 1969)

Tjilpúrung tjilpurú	*Tjilpuru*
ngandireéla ngapiréla	Your mother, your father
ngardula pirdaraï	Are cracking nardoo seed
ngampa yarra	The stone is there
Tjilpurúng tjilpurú	*Tjilpuru*

The grandmother sang to the boy *Tjilpuru* and he answered her. The Yarluyandi song consisting of the boy's verse is as follows, according to Tom Naylon (June 1981):

Ngandriteji nagpi	Mother, father
WaRila patjiyarra riimu	Fish they are catching . . .
Ngatatali kanjinina waa	Mother's father, mother's mother oh!
Ngardulu pandri	Nardoo they pound.

The Bush-lark people kept the nardoo stone for ever after and *Kurkari* travelled on without it; he was looking for a wife further south in Ngamini country.

Text 6. Kimili and the Two Women

Linda Crombie (of Wangkangurru and Yarluyandi descent) was able to relate several stories connected with *Kimili Kanti-purru*, 'Carrying a Waddy':

1. *Mathapurda-pula karna njara thidnangkara-nganha mathapurda Kanti-purru-nha. Kurkari yuka-rnda pula*
   Old man-two man young north-from, old man Kanti-purru-PROP. Kurkari go-PRES two
   Karlatjuwarri. Karlatjuwarri-nganha ngarritji-rna-yiwa-rna arnari.
   Kalidawarry. Kalidawarry-from go down-SP-TR-IMP this way.
2. *Mayarla-thu nguru thu yuka-ngura mathapurda mankarra-pula-nha thiki-ra Kurkari-thu*
   Leave him-EMPH other-EMPH go-CONT old man girl-two-ACC take-PUNC Kurkari-EMPH
   kaRu.
   there.

3. Two of them come down, *mathapurda nguru-ki* *Kanti-pureru-nha*, stop there at the *Kanti-purru*, *karna*
old man other-EMPH Kanti-purreu-PROP man
nguru yuka-ngura mankarra wapa-wapa-rna, mankarra kapu-kapu mathapurda Kurkaria.
other go-CONT girl seek-PRES, girl look for[1] old man Kurkari.
Kanti-purru katha-nangka-rda He was Snake too.
Kanti-purru wander round CONT S-PRES.
4. *Tharna-pulu-tjintjini, uljurla-pula thanga-rnda karla pangki-nga, muyu-nga. kanhangarda pula*
'Vagina-two-warming' woman-two stay-PRES creek side-LOC sun-LOC there two
thati-nangka-rda thaRalju thaRi- thaRi-nha, thaRalju thaRi, they was killing'm, tjirka-purru thaRalju
eat-CONT S-PRES frog small small-ACC frog small tail-having frog
pula tharni-thangka-rda. warpi-nangka-rda pula thangka-rda.
two eat-stay-PRES lie-CONT S-PRES two sit-PRES.
5. *Mathapurda uka yuka-ka. Ah njipa-parlu awarda thanga-rnda! tharna-ku nhanhi-lhiku warrritha-ru*
Old man he go-PAST Ah, clothes-bare there stay-PRES! vagina-DAT see-HIST afar-ABL
mathapurda-ru!
old man-ERG!
Tharna-pulu-tjintjini, they were rattling with sand.
6. *Kanti-purru ngarritji-rna-yiwa-rna. kanhangarda karla-nga thangka-ka uljurla-pula.*
Kanti-purru descent-SP-TR-IMP there creek-LOC sit-PAST woman-two.
7. *Athu nhanhi-ra minha-minh' anthunha! Thika-ngarra thika-ngarra arnari yuka-rnda arni nhanhi-lhiku!*
I SEE-PUNC what-what mine! Return-IMM return-IMM this way go-PRES us see-PURP!
8. *Uka-ru yaka-yaka rna uljurla, uljurla-pula-nha yaka-yaka-rna thika-rna thangka-lhuku.*
He-ERG chase-chase-IMP woman, woman-two-ACC chase-chase-IMP. go back-IMP sit-PURP.
9. He fell in love with those two women then, but they ran off to the *Danta-parkulu* sandhill.

Text 6. Translation

1. Two men, newly initiated, came from the north. These two men *Kanti-purru* 'the one carrying a waddy' and *Kurkari*, the Green Snake, went to Kalidawarry waterhole (near Lake Muncoonie in Wangkamadla country). From Kalidawarry they came down this way.
2. Saying 'I'll leave him' one of them went on, it was *Kurkari* who went over there (to Two Wells near Mt Gason) to take away two girls from there.
3. Two of them had come down: one was *Kanti-purru* 'Carrying the Waddy' (*i.e. Kimili*, the Black Snake) who stopped there at the *Kanti-purru* sandhill, the other one went on in search of girls, he was old man *Kurkari*, the one who was looking for girls among the Ngamini. *Kanti-puru* stayed just wandering around on the sandhill. He was a Snake too.
4. At the place called *Tharna-pulu-tjintjini* two women were resting in the sun by the bank of the creek (the Eleanor). The two of them were eating frogs, they had been killing those little tadpoles, the ones that still had a tail. They stayed there lounging about, eating.
5. The old man came – ah they were there with (of course) no clothes on! The old man saw their vaginas from afar at *Tharna-pulu-tjintjini* (as they were warming themselves up with hot sand), rattling with sand.
6. *Kanti-purru* came down as the two women were there by the creek.
7. 'Ah, I see something here that is for me!'
'He's coming down, he's coming back this way to have a look at us!'
8. He chased them, he ran and ran after the two women, he wanted to come and stay with them.
9. He fell in love with those two women then, but they ran off to the *Danta-parkulu* sandhill.

Reuther was obviously told some of this story because he has the following entry in his list of place names (Vol. VII: 2044):

> Tanabulutindi
> Tanabulu 'the female sexual organ', tindi 'to warm'.
> Kimilina observed how they (certain women) strewed hot sand on these parts for they had syphilis(!).

Reuther gives no further information.

Kimili continued along the Eleanor naming the country and lending his grinding dish. There is a song, partly in Yarluyandi, connected with him and with all the people now grinding flour. This was sung by Tom Naylon in 1982 shortly before his death but as there is no adequate translation of the words it has not been included here. *Kimili* then left, taking his grinding dish with him, and he travelled all the way to near Coongie Lake where he ultimately put it down. It had worn him out, literally crushed him, because it was altogether too big and heavy. Songs now lost described his journey. The stone is said to be still there, near Coongie, as a large rock.

The story of the two Snake Ancestors is significant in a number of ways: it illustrates the fact that there was a band of mythological lines that came from the Mulligan up north and traversed Karangura country going down the Georgina towards Yarluyandi and Ngamini country. This was one of the main routes for

[1] This is a Ngamini expression meaning 'look for' and it is a direct quotation from the Ngamini story of *Kurkari*, see Hercus & Potezny (1990).

the pituri trade (Watson 1983: 30), and probably also for the importation of grinding stones. The Snake Ancestors thus followed a well established course and Karangura people occupied a central position in the tradition. The *Danta-parkulu* sandhill where the two women find refuge is halfway between the Eleanor and the main Diamantina channel. It was an important Grub Increase site and probably both Yarluyandi and Karangura people joined in rituals there.

C. Mirithira, the Grub-Powder Man

Reuther knew about the ancestor '*Miritira*' (Vol. X: 90) and wrote of him as coming from 'Turuwarapu on the other side of Salt Creek'. He associated *Mirithira* with grub powder [for details on the preparation of which, see Hercus (1989)] and with Grub Increase rites. Linda Crombie however knew of him mainly as the ancestor who dwelt at the Andrewilla waterhole and who created the trees at Two Wells.

Text 7. Mirithira

1. *Mathapurda Mirithira-nha Wirluma-nganha karla-li ngarritji-rnda.*
   Old man *Mirithira*-PROP *Wirluma*-from creek-ADV descend-PRES.
2. *Uljurla-kari-ri Ngantarawirli-nga kari-ri pardi mapa-lhuku. kudnakardi kilta-rna, thawi-lhiku,*
   . . . Woman-they-ERG Andrewilla-LOC they-ERG grub collect-HIST guts pull-out-IMP throw-PURP.
3. *Mirithira-ru mathapurda-ru uljurla kari-nha yabmi-rna kudna kilta-lhuku; kudna kilta-rna*
   Mirithira-ERG old man-ERG woman they-ACC growl-IMP guts pull out-PURP, guts pull out-IMP
   thawi-lhiku, wadnhi-lhiku pardi maka-ra watji-rna
   throw-PURP cook-HIST grub fire-CAUS roast-IMP
4. *Pardi pulpa pirda-nangka-lhuku ngampa-ru uljurla-kari-ri.*
   Grub powder beat-CONT S-HIST nardoo stone-INST woman-they-ERG.
5. *Mathapurda Mirithira-ru yabmi-rna kari-nha; uljurla kari-ri ngampa kultji*
   Old man Mirithira-ERG growl-IMP they-ACC; woman they-ERG nardoo stone hammer stone
   mani-ra pirda-lhuku pardi kari-nha, pardi pulpa tharni-lhiku waya-rnda.
   take-PUNC smash-PURP grub they-ACC, grub powder eat-PURP wish-PRES.
6. *Pulpa-purru yuka-ka kari-ri kutha ngunhi-rna uka-ru widni-wa-rna.* Bank got washed away now,
   Powder-having go-PAST they-ERG water give-IMP he-ERG take away-TR-IMP
   ngarrimatha-nga. puthu parkulu there, each time he eat'm *nguru uka-ru tharni-ra*
   flood-LOC. dish two other he-ERG eat-PUNC.
7. *Nganara-wirli-nga uka-ru yabmi-rnda uljurla-kari-nha. Nganara-wirli-nga, wanka-yiwa-rna yuka-lhuku*
   Steep-Bank-LOC, he-ERG growl-IMP woman-they-ACC. Steep-Bank-LOC, walk up-TR-IMP go-PURP
   kaRuku-thu Danta-parkulu-ruku
   there-ALL Powder-two-ALL.
8. *Kanhangarda uljurla-kari-nha kaRi-lhiku-thu pardi pirda-nangka-rda-nha, pardi pulpa. widna-yiwa-rna*
   There woman-PL-ACC see-HIST-EMPH grub beat-CONT S-PRES-NP grub powder steal-TR-IMP
   thunka-thunka-la-ru kari-kunha,
   deprive-APP-NAR they-POS.
9. *Mama-rna thunkuthunka-la- yabmi-la-mintja-nta kari partjarna, mathapurda thangka-nangka-rda*
   Grab-IMP deprive-APP- growl-APP-RECIP-REFL they all, old man sit-CONT S-PRES.
10. *Kari-ri nhanhi-ra ngamarla arluwa-kari thudni-rnda wadla-ra*
    They-ERG see-PUNC pitiful child-they cry-PRES hunger-CAUS
    cruel, I don't like to talk about it, cruel old man *nguyu-ru tharni-lhiku arluwa-kari ma ma ma ma ma!*
    alone-ERG eat-HIST child-they boohoo, boohoo, boohoo
    thudni-nangka-rda ngamarla kari.
    cry-CONT S-PRES pitiful they.
11. *Kudnala witji-rna. Uljurla kari thampa-rda manii-lhiku puthu 'kanha, manta puthu, pitjatja;*
    Asleep become-IMP. Woman they sneak-PRES take-PURP dish he-ACC, take away dish bark dish;
    wadna-rda-nhara kudnala kurda-ngura uka,
    run away-SP-OPT asleep lie-CONT he.
12. *Uljurla-pula thampa-rda, mathapurda kurda-yi-ngura yatu, kangi tharni-limaru. Uljurla-ru*
    Woman-two sneak-PRES, old man lie-ACT-CONT full, too much eat-PLUP. Woman-ERG
    mama-rnda, mama-rna- thika-rna wardukupa ngunhi-lhiku.
    grab-PRESS grab-IMP return-IMP child give-PURP.
13. *Uta thurka-rnda mathapurda thanta wapa-lhuku, uta pula wana-wana-ya-ngura*
    Now get up-PRES old man things look for-HIST, now two run-run-TR-CONT
    yabmi-la-mintja-nta pula mathapurda uljurla.
    swear-APP-RECIP-REFL two old man woman.
14. *Mathapurda mani-lhiku waya-ngura uka-nha pardi-pulpa; mani-rnda, yabmi-rnda uljurla-ru:*
    Old man take-PURP want-CONT he-ACC grub-powder; take-PRES, growl-PRES woman-ERG:
    maljka maljka thiki-thiki-la-Ru!
    not not take-take-APP-IMP!

15. *Mayarla uljurla-ru pirda-nha, mathapurda warlu thika-rna.* Two Wella-*ruku*
Let it be woman-ERG beat-NP old man sullenly enraged go back-IMP Two Wells-ALL
thika-lhuku
go back-HIST.
16. *Partjarnda thika-rnda Danta-parkulu* sandhill.. *purku-witji-rna* at two mile from Andrewilla. *Pardi*
All return-PRES finish-become-IMP Grub
patharra witji-rna pardi pulpa pirrpayi-rna that is where that *patharra* green.
box tree become-IMP grub powder spill-IMP
17. *Thika-rna mathapurda kudnangkari thika-rnda* them *patharra* I showed you, at Two Well, *thangka-rda*
Go back-IMP old man south go back-PRES sit-PRES
purku-witji-rna
finish-IMP.
18. *Mathapurda-ru pardi watji-rna, pardi katharrayi-rna* at the Two Well there. You know them trees we seen those
Old man-ERG grub roast-IMP grub burst-IMP
parranta-wili, but different ones again. *pardi paltungka-rda katharrayi-rna* that is how them trees come.
grub explode-PRES burst-IMP

Text 7. Translation

1. Old man *Mirithira* came from Wirluma (a fire ritual centre far to the north in Wangkamadla country).
2. At Andrewilla some women were collecting grubs. They pulled out the guts and threw them away.
3. *Mirithira* swore at the women to gut the grubs. They pulled out the guts to throw them away, and then they cooked the grubs; they roasted them on the fire.
4. The women were continually smashing the (roasted) grubs to powder on a nardoo stone.
5. Old Man *Mirithira* went on swearing at them. They got nardoo stones and hammer-stones and smashed up the grubs because they wanted to eat grub powder.
6. They would walk along carrying their grub-powder, and when they went to get water he would come and steal it. (His camp was by a) bank which got washed away by the big flood. He had two coolamons there (filled with grub powder). He would eat one lot after another.
7. At Andrewilla 'The Steep Bank' he swore at the women. They walked up and left Andrewilla, they went over there, to *Danta-parkulu,* the 'Two lots of powder' sandhill.
8. There he saw the women grinding up grubs. He stole the grub powder, he took away all they had.
9. He grabbed (the powder) taking it away from them. They all swore at him and the old man swore back at them and then he just sat there (eating their grub-powder).
10. They looked on, the poor little children, and they cried and cried from hunger. It was a cruel thing and I don't like to talk about it. He was a cruel man. He ate it all on his own and the children were crying the whole time boohoo, boohoo, the poor things.
11. He fell asleep. The women sneaked up to grab his dish. They took the dish, a bark-dish, and they wanted to run off with it as he lay there sleeping.
12. The two women sneaked up as the old man lay there, bloated, having had too much to eat. The women grabbed (the dish of grub-powder) they grabbed it and came back to give it to the children.
13. Then the old man got up to look for his things, and the two women were already running away, and both (sides), the man and the women screamed abuse at each other.
14. The old man wanted to take away their grub powder; he took it and the women yelled at him: 'Don't, don't take it away from us!'
15. 'Let the women go on pounding (the grub powder) then!' With this the old man left in a sullen rage and went down to Two Wells.
16. All (the women) went back to the *Danta-parkulu* sandhill and they finished there, two miles from Andrewilla. The grubs turned into box trees, wherever the women spilt grub powder that is where you see those green box-trees.
17. The old man went away down south, those box-trees I showed you at Two Wells, that is where he stayed and where he finished.
18. The old man had roasted some grubs there (without bothering to take the guts out). Those grubs burst. That happened at *Kurtjuru* Two Wells. You know those trees we saw there, like a type of eucalypt, but different again? The grubs exploded and burst, that is how those trees came to be there.

D. Other Minor Myths

Goannas

A small waterhole east of Kooringala is called *MiRandani* 'Feeling sore'. This Karangura place-name is comprehensible in terms of Yarluyandi, where *miRa* means 'a sore'. A female Ancestor was here. She rested at the waterhole suffering from skin sores. These ultimately became spots as she turned into a Goanna and went off to join the other Goannas in their main camp at the nearby *Midla-kapirri*, 'Goanna Nose' waterhole. It seems that this was a localised Karangura tradition, though according to Reuther (Vol. VII: 2035), *Turaki*, the Terachi waterhole was also associated with the Goanna story.

FIGURE 5. The *Pirlitji* sandhill, centre of the Willie Wagtails myth. Photograph: L. A. Hercus.

The Willie Wagtails

The *Pirlitji* sandhill (Fig. 5), south-west of Koonakoo waterhole (Fig. 6), was the centre of a Karangura myth about Willie Wagtails. Linda Crombie had only heard the outline of the story: a war-party of Willie Wagtails came from Annandale to fight the local birds camped at this sandhill. The intruders lit their camp-fire close by and shouted challenges. The word *Pirlitji* which is Karangura, apparently refers to this fire. After a big fight the war-party had to retreat to Koonakoo waterhole, where they split up. The main party returned to the Annandale country while a small group travelled south via *Kalkapurritjinha*. Koonakoo waterhole was said to be at the centre of a Dog myth, now lost.

E. Kujumokuna

This Karangura ancestor was no longer remembered by Yarluyandi and Wangkangurru people but information is obtainable in the work of Reuther. He states (Vol. III: 1211):

> Kujumokuna was one of the tribal ancestors of the Karangura. From kuju = kidni in Diari 'penis' and 'moku bone' meaning: 'the bone [-like tissue] in a man's penis.' He makes his appearance as a witchdoctor among the Karanguras to the north. He was killed at Kudnangauana. With him originated sorcery by boning. Since he possessed magical powers as a witchdoctor, even [after his death] his bones still had magical effect. They were therefore gathered up and used for purposes of witchcraft. Today, when a human bone is sharpened to a point: on a stone, his invocatory songs are [still] sung, so that the bone receives [the desired] magical power.

All these myths show that there were particularly close mythological links between the Karangura and Ngamini and Yarluyandi, and particularly with the Wangkamadla people to the north. There were close trading links, not only in pituri and probably grinding dishes as discussed above, but also in other goods. Thus speaking of some special fossil bones called 'kuripikiri', Reuther writes (Vol. III: 126):

> The kuripikiri, then, found in the district of the Marungarli tribe, is passed on as an article of trade to the Karanguras, then to the Ngamanis, coming down finally to the Diaris, and is dearly paid for in kind. The animal, from which it is derived, is unknown to the 'native' people.

Karangura people were not on their own; that is why at least some of their traditions have survived among their neighbours.

Major Karangura Myths And Rituals: The *Warrthampa* And The *Mindiri*

The myths we know most about are the major travelling myths which traverse the area and which are associated with important rituals. We get some idea of the Karangura part of these because neighbouring groups knew how the whole 'line' of myth was connected. A number of lines went through Karangura country. These were: the Swan History, which is however mainly Yarluyandi, the Seven Sisters (see text 1 above), the Initiation History of the Two Men, a short sketch of which was published by Howitt & Siebert (1904) and Howitt (1904), and the Two Boys History.

The story of the Two Men who introduced the Circumcision knife is part of the tradition of all the Lake Eyre people, but the Karangura had a special part in the myth. This is evident not only from the work of Howitt and Siebert, but also from that of Reuther. The whole song cycle has been recorded from Wangkangurru men by the author, but long sequences of it are secret.

Two rituals attracted the largest groups of people in the eastern Lake Eyre Basin. These were the *Mindiri*, which was connected with the Emu History, and the *Warrthampa*, which was connected with the

FIGURE 6. Koonakoo waterhole, adjacent to *Pirlitji* sandhill. Photograph: L. A. Hercus.

Two Boys. There is a brief description of the *Mindiri* in Berndt (1953) and Horne & Aiston (1924: 37–44). The *Mindiri* belonged basically to the Cooper, but it reached as far north as Koonchera and Lake Etamunbanie, and therefore the Yawarawarrka and their neighbours the Karangura were involved. It did not traditionally belong to the Wangkangurru. Both of these ceremonies were variously described by people who had actually taken part in them as being 'larrikin', and 'rude'; they involved sex and were 'good fun'. There is no doubt that large numbers of people took part. Gason (1895: 174), writing about the 'Mindarie' says:

> Dance or peace festival, all the tribe and the neighbouring tribes are invited to attend. Promiscuous sexual intercourse is carried on secretly: many quarrels occur at this dance. I have seen as many as 1000 take part on a hard clay flat, lit up by fires kept burning by the women.

The *Warrthampa* is mentioned only rarely in the literature. Reuther in writing about it may have misunderstood some of the comments of his informants as he attributes to the followers of the Warrthampa sentiments that seem more in keeping with German romantic ideals than with the usually more practical Aboriginal views. He writes about the *Warrthampa* as follows (Vol. X: 21):

> This muramura is venerated in the vicinity of Birdsville and further northwards. He is regarded as the father of all kana (men). Should any man be slain by a pinga (vengeance party) but have previously sung the Wadumpa-song, he can meet death fearlessly.

Further information is given by Howitt and Siebert, in their account of the legend of the 'Wapiya girls' (1904: 120):

> After a time they came to a place where a number of men had assembled for the Wodampa dance, who strangled the girls, being enraged because they had seen what it was not lawful for them to see.
> The Wodampa dance is the most sacred dance the Wonkamala and the Ngulubulu have. It recounts the origin of mankind.

Even these scarce sources leave no doubt that the *Warrthampa* was a most important ritual and it belonged to the northerly groups, precisely those that did not traditionally participate in the *Mindiri*. The one exception were the Karangura: they had an important part in both, and particularly the *Warrthampa*.

The Warrthampa is linked with the myth of the two (Rainmaker) Boys who travelled from Witjira (Dalhousie) across the Simpson desert to Karangura country. They then headed north to Itabucca Springs and Glenormiston and ultimately returned to Dalhousie. Like the other ancestors discussed above, the Two Boys followed the same pituri route, but this time from south to north: they went up the Georgina and then up the Mulligan. There was an immense song-cycle connected with this myth, part of the Simpson desert section and the Karangura portion were remembered by Mick McLean. At various times he and Maudie Naylon *Akawiljika* spoke about the *Warrthampa*:

Text 8. The Warrthampa

(From Tapes 112, 138–40 (1966); 157 January (1967), Mick McLean speaking at Marree, and Tapes 515 (1972), 675 (1975) Mick McLean speaking at Birdsville and Port Augusta)

1. Maudie was talking about *kira* *ngarra-la-lhuku* in that *Warrthampa* - that's *kari-kunha, maljka*
   boomerang rattle-APP-HIST they-POS, not
   nguru thanga-rnda ngangka, partjarna wapayi-kanha,
   other remain-PRES alive, all die-PERF.
2. I have been hear'm long time, *kira* *ngarra-pa-rna* *Warrthampa-ku* those days *Warrthampa* was
   boomerang rattle-INT-IMP *Warrthampa*-DAT
   thamunha arla, uljurla-ru *ngawi-rna* all right, *ngawi-rna* *uljurla-ru!*
   secret true, woman-ERG heat-IMP hear-IMP woman-ERG!
3. *Athu unha* *nguntayi-ra arlali:* *uljurla* got to pay'm that *Warrthampa arla* in that, *Mindiri-wili.*
   I you ACC tell-PUNC finally: woman *Warrthampa* true *Mindiri-* like.
4. *Warrthampa* is my country, that is more dear! *Mindiri* is nothing, rubbish! *Maljka 'ntha waya-rnda!*
   Not I want-PRES!
5. *Kayi Witjira-ru* *yuka-kanha Thuthirla-pula kanhangarda nhingka-yiwa-rna,* along Lagoon waterhole,
   This Dalhousie-ABL go-PERF. Boy-two there glance-TR-IMP
   Kandritja, nhingka-yiwa-lhuku nhanhanga thuRu-thuRu kadnha-thidla thangka-ngura kanhangarda pula
   glance-TR-HIST here *island* hill-bit sit-CONT there two
   nhingka-rna-yiw-anka-lhuku kardapu-nga nhingka-rna-yiwa-lhuku.
   glance-SP-TR-INCH-HIST head-LOC glance-SP-TR-HIST.
6. *Kandritja Ngamani-kunha wadlhu-nga. Tharka-ngura kaRu irlangkurda: athu 'nha ngunta-ka*
   'Waterhen' Ngamini-POS country-LOC. Stand-CONT there thus: I you show-PAST
   kanhangarda nhingka-yiwa-lhuku Warrthampa, kira *ngarra-la-lhuku.*
   there glance-TR-PURP boomerang rattle-APP-HIST.
7. *Pula wanka-rda, wadlhu-ru* *pula wanka-lhuku, kardapu-li* *wanka-lhuku,*
   Two rise-PRES, ground-ABL two rise-HIST, head-ADV rise-HIST
   just the tops of their heads coming out.

8. *Pula ngatji-rna karna ngura-nganha. Wintawi-rna thika-lhuku, ThuRu-ki-thi thika-lhuku*
Two see-IMP man camp-from Dive down-IMP return-PURP, below-EMPH return-HIST
wadlhu-nga thuRu.
ground-LOC inside.
9. *Pula wadlhu-ru wanka-rda kanhangardanga. Warrthampa-kunha-lki,* they living here, *Warrthampa,*
Two ground-ABL rise-PRES there. *Warrthampa*-POS-EMPH
ngarra-l-ta kira kari-kunha ularaka.
rattle-APP-PRES boomerang they-POS History.
10. *Ngurlupurlu, Marrunga,* you know Durie. They got that full History. My country *ngalingali.*
beginning (?).
11. *KaRu yuka-ngura kanhangarda karla-nga-li, kaRu tharka-thika-lhuku Kadrikudna-nha,*
There go-CONT there creek-LOC-EMPH there stand-return-HIST *Kadrikudna*-PROP
tharka-rna kaRu irlangkurda, in the middle of that flat down from *Kuntjirri, kaRu thika-rna.*
stand-IMP there thus there return-IMP.
12. *Thutirla-pula* all the feathers of that bird they *pirda-ka pirda-rna munta-nga kalpa-lhuku yakuta-nga,*
Boy-two kill-PAST kill-IMP bag-LOC collect-HIST bag-LOC,
wantarda: paya nguru paya nguru pirda-ngura, wantarda kalpa-lhuku.
down: bird other bird other kill-CONT down collect-PURP.
13. *Kuyatiyarri paya* call'm *kuyatiyarri. wakarda pirda-rna 'kanha pula-ru, kathangka-rda, paya*
Orange chat bird orange chat that kill-IMP him two-ERG wander-IMP, bird
warrangka-rda.
chase-PRES.
14. *Wantarda iki-rna, pula-kunha thanta, pitji-lhiku, kari pitji-rna kanhangarda ngura-nganha.*
Down carry-IMP, two-POS things, paint-PURP, they paint-IMP there camp-from.
15. *Warrthampa kanhangarda nhanhi-wa-rna. pula-ru, wantarda ngunhi-wa-rna: 'nhalara urkari*
there see-TR-IMP two-ERG, down give-TR-IMP: 'this-CAUS you
pithi-nha-ka, maljka yalkirri irlangkura, yalkirri, malja malja nhanha thawi! maljka malja-ra
paint-NP-for ever, not gypsum thus, gypsum kopi, kopi this ACC throw! not kopi-CAUS
pithi-nha! nhala-ra wantarda-ra pithi-nangka-rda!'
paint-IMP this CAUS down-CAUS paint-CONT S-PRES!'
16. That is the *Warrthampa* there, *kari thika-rnaya-rna Warrthampa pula-nha wanta-thika-ngura.*
they return-TR-IMP two-PROP follow-return-CONT.
Maudie been tell you, *kari thika-rna nhanhangu-ru tharka-thika-lhuku Yabmalkira-nha yatjalka-nga*
they return-IMP here-ABL stand-return-PURP *Yabmalkira*-PROP lignum-LOC
thangka-ngura kaRu Kutiri-nga -that's *Kutiri,* supposed to be *mikiri* there, belonging to Karangura country,
stay-CONT there *Kutiri*-LOC
Karangura *ngura.*
17. *Mingka-nga witji-rna-thika-lhuku thuRu thika-lhuku, pula Kutirinja-ruku, ama-ki-ti*
Hole-LOC become-SP-return-HIST below return-HIST two Kutirinja-ALL, mother-EMPH
manta-yiwa-lhuku.
take-TR-PURP.
18. *Pula-ru paku-ru kira thawi-rna warra-rna,* didn't know *mathapurda* over there, *mathapurda*
Two-ERG empty-ABL boomerang throw-IMP play-IMP, old man old man
ngura-nganha thangka-ngura, kira-ra uka-nha palji-rna, kira uka-irnda kurda-yiwa-rna yadla
camp-from sit-CONT, boomerang he-ACC aim-IMP, boomerang he-ALL fall-TR-IMP close
uka-irnda.
he-ALL.
19. *Mathapurda-ru nhanhi-lhiku wadlhu partjarna, 'ah nhawula pula palji-ra anthirda kira*
Old man-ERG see-HIST country all, 'ah these two two strike-PUNC me ALL boomerang
antirda awarda thawi-ra!'
me ALL this throw-PUNC!'
20. *Kanti mant' uka-ru midla pula-nha puntji-lhiku; kanti mani-lhiku mitdla pula-nha uka-ru*
Waddy take he-ERG nose two-ACC flatten-PURP; waddy take-HIST nose two-ACC he-ERG
kuntili kanti nguyu-ru midla pirda-rna parkulu manhi pirda-rna.
crossways waddy one-INST nose hit-IMP two self hit-IMP.
21. *Kuti-rna pula-nha kanti-ri midla pirda-rna. Kutirinja* that's in the Georgina.
Drag-IMP two-ACC, waddy-INST nose hit-IMP.
22. *Kubmarri mani-lhiku uka-ru kubmarri puntha-ru: ah Witjira-nganha thutirla-pula Witjira-nganha!*
Blood take-HIST he-ERG blood drink-NAR: ah Dalhousie-from boy-two Dalhousie-from!
23. *'Ah, Witjira-nganha'* all them ground he tell'm then, all them water, *mikiri.* He tell'm Karangura way. Karangura and Wangkamadla mixed. All that *Parra-parra, MaRapardi,* that's the last Simpson water, that's in my country.
24. *Pula kaRuku yuka-ka Wangkamadla yani-rnda.*
Two there-ALL go-PAST say-PRES.

25. The karangura man sang:
Wĭtjirinja ngĭntja ngali karntayá,
Párra-parranja ngĭntja ngali karntayá, aah
Káruljárinja ngĭntja ngali karntayá
Párra-parranja ngĭntja ngali kárnta
MáRapardinja ngĭntja ngali kárntayá, aah
Káruljárinja ngĭntja ngali karntáya
Púlawáninja ngĭntja ngali karntáya.
Wálpurakáninja ngĭnja ngali karntáya

26. I don't like singing that because I wouldn't know what he is saying there, I just know that *karntaya* means going along, going into another country. They're doubling up all those places where they've been:

27. (The Karangura man sang again):
MáRapardi ngĭntja ngali kárntayá
Káruljárinja ngĭntja ngali kárntayá
Wárru-wárru ngĭntja ngali kárntayá
Púlawáninja ngĭntja ngali kárntayá
Wálpurakáninja ngĭntja ngali kárntayá
Káruljárinja ngĭntja ngali kárntayá.

28. That sound funny to me, I don't like singing'm. Ha! That is where he names all the *mikiri*, my country, follow all that, Karangura way, That's all places, he mixes them up in that song. They change their voice over there.

29. *Wangkamadla kanhangarda thimpa-rda ularaka waRa-nganha waRa-nganha mikiri, intjali intjali*
Wangkamadla there speak-PRES History what-from what-from well, where where
yuka-kanha thimpa-rda
go-PERF speak-PRES.

30. *Nganka-ma-lhuku.* Karangura country where he tell'm that *Witjira-nganha*, then he went on to *Kuringala*
Alive-make-HIST. Dalhousie-from
waterhole, and to where Jack Gaffney got his station, *Dikirri.*

31. *Wadlhu-nga winta-kurda-lhuku thika-rna pula yuka-lhuku karla-li yuka-lhuku Kira-ngarrapani.*
Ground-LOC hide-lie-HIST return-PRES two go-HIST creek-ADV go-HIST Herbert Hut.
Walta yuka-lhuku pula ama pula-kunha ngataru yuka-rnda.
Together go-HIST two mother two-POS behind go-PRES.

32. *Yuka-lhuku kaRu tharka-yiwa-rnda* along *Kira-ngarrapani-nha.* Ah, that is where the netting crosses
Go-HIST there stand-TR-PRES Boomerang-rattling-PROP.
through the Queensland border!

33. *Kira ngarra -l-ta.* When they were singing, must have been. That is what you call
Boomerang rattle-APP-PRES.
Kirangarrapani, 'Making the boomerangs rattle.'

34. *Kanhangarda thangka-yiwa-rnda, kira ngarra-li-nda* again, *pula-kunha ngaRu Witjira-nganha*
There sit-TR-PRES, boomerang rattle-DIST-PRES two-POS style Dalhousie -from
they copied it - no, it is there.

35. And that *Kudnarri* 'Overflow' over there, what they call that? Then they go along Adria Downs, big swamp you see, those two *wiya* been go, *thutirla-pula warrukathi warrawa-rna ha ha! pula thika-rna*
young boys boy-two emu chase-PRES ha ha! two return IMP
thangka-yiwa-lhuku, must have been *kurdarna* I suppose, *Kirangarrapani.*
sit-TR-HIST sleep Herbert Hut.

36. *Wadnayi-nangka-rda paya muyu nguru muyu nguru wara-nangka-rda,* killing all the birds for different
Chase-CONT S-PRES bird day other day other play-CONT S-PRES
wantarda Warrthampa-ku
feather *Warrthampa* -DAT.

37. *Ukaliri yuka-rna -wanka-lhuku, karla-li karla-li yuka-nangka-rda ama pula-kunha yuka-rnda*
Then go-IMP-go up-HIST, creek-ADV creek-ADV go-CONT S-PRES mother two-POS go-PRES
ngataru, puthu wanpa-rda kutha-puthu kutha-purru puthu canteen *wili.*
behind, dish carry-PRES water-dish water-having dish like.

38. *Yuka-lhuku kaRu Kati-tharri,* got headache there, *Kati-tharri*, that is headache in Wangkamadla, *Kati-tharri*
Go-HIST there Old Annandale
is Wangkamadla, Wangkamadla and Karangura mixed anyway.

39. *Yuwu padni thadlhu wadlhu-lki*
Man nothing empty country-INF.

Text 8. Translation

1. Maudie (Naylon *Akawiljika*) was talking about how they rattled the boomerangs in the *Warrthampa*[2]. That (part of the ceremony) belonged to those other people (*i.e.* the Karangura), there is not a single one of them living now, they all died out.
2. I heard about it a long time ago, how they rattled the boomerangs for the *Warrthampa*, in those days it was well and truly secret, but women could listen to it all right, oh yes, women could listen to it!
3. I'll at last tell you the truth about it: the women have to pay for this (*i.e.* by means of sex), the real *Warrthampa*, it's just like in the *Mindiri.*

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2. Maudie Naylon had demonstrated a few days earlier how people used to make boomerangs rattle in the *Warrthampa* ceremony. They held two boomerangs close together and made them touch each other with a rapid vibrating motion.

4. The *Warrthampa* belongs to my country, that costs more![3] The *Mindiri* is nothing, just rubbish! I have no time for it!
5. The Two Boys had come from Dalhousie, they had a quick glance round, that was at Lagoon Waterhole, which is called *Kandritja* (= Koondaritchinna waterhole on modern maps), they quickly glanced around. There's an island in the waterhole, a little bit of a stony rise, that is where they were, the two of them, just looking around quickly before departing. They just glanced round as they came out (from under the ground) head first.
6. The *Kandritja* 'Waterhen' waterhole is in Ngamini country. I showed you the place. That is where they were having a quick look for the *Warrthampa*, because they could hear the boomerangs being rattled (from afar at *Kira-ngarrapaninha*, Herbert Hut).
7. The two of them came up, they came up from under the ground head first, with just the tops of their heads showing.
8. The two of them saw a man belonging to that place, so they dived down under the ground again and went back, travelling underground.
9. The two of them came up from under the ground. They belonged to the *Warrthampa*, the people living there, and they rattled boomerangs for the (ritual belonging to) their History.
10. Ngurlupurlu and Marrunga people, you know those from Durie, they have got the full History. My country is the first part.
11. They went there along the creek and they stopped at *Kadrikidnanha*, that is in the middle of that flat down from *Kuntjiri*, that is where they went.
12. The Two Boys had been killing a lot of birds for their feathers, they went on killing them to collect the down-feathers in a bag, a large bag. They killed all kinds of different birds to collect down-feathers.
13. The birds called orange chats, they were the ones that the Two Boys killed. The two travelled around chasing birds.
14. They carried the down-feathers round with them, ready for painting up (for a corroboree) the Two Boys painted up the people from the camp.
15. The Two Boys had gone to have a look at the *Warrthampa* and they handed over their feathers. 'You all paint up with these from now on and for ever! Not like that with gypsum crystals, with kopi! Throw away this kopi! From now on you will always paint up with these!'
16. They had the *Warrthampa* there, and the Two Boys went round following the *Warrthampa*. Maudie was telling you, they went back from this place to stay around *Yabmalkira* 'Clifton Hills' and then at *Kutiri*. There is supposed to be a native well there, belonging to Karangura country, a Karangura camp.
17. The two of them went down inside the hole to go back underground to *Kutiri*, to pick up their mother.
18. The two threw boomerangs about for fun, playing. They didn't know an old man was over there, an old man belonging to that place was sitting there. They threw a boomerang in his direction: the boomerang landed right close to him.
19. The old man looked round in all directions: 'Ah, here are those two that threw a boomerang at me!'
20. He picked up his waddy to flatten their noses, he took his waddy and hit them both over the nose with a crossways blow, hitting both their noses with the one (blow) of his waddy.
21. He dragged the two (unconscious bodies) along the ground, he had hit them over the nose with his waddy. *Kutirinja* (which means 'dragging'), that is in the Georgina.
22. He got (a drop of their) blood and tasted it: 'Ah', he said 'Those two boys come from Dalhousie!'
23. 'Ah, from Dalhousie!' (he said) and he named all the places, all the wells, the *mikiri*. He sang about it in the Karangura way. Karangura and Wangkamadla mixed. He named them all, *Parra-parra*, and *MaRapardi*, that's the last (westernmost) Simpson Desert well, that's in my country.
24. He was talking in Wangkamadla about the places where the two of them had gone.
25. The Karangura man sang:

    (From) Dalhousie I, we two travelled,
    Karulinja that is where I, we two travelled,
    Burraburrinna, the long well-shaft that is where I, we two travelled,
    Murraburt that is where I, we two travelled,
    Karulinja that is where I, we two travelled,
    Pudlowinna that is where I, we two travelled,
    Wolporican that is where I, we two travelled.

26. I don't like singing these verses because I don't know what he is saying there. I just know that *karntaya* means going along, going into another country. They're 'doubling up' (mixing up the order of) all those places where they've been.[4]
27. (The Karangura man sang again):

    Murraburt that is where I, we two travelled,
    Karulinja that is where I, we two travelled,
    Warru-warru 'the White One' that is where I, we two travelled,
    Wolporican that is where I, we two travelled,
    Karulinja that is where I, we two travelled.

28. (Those verses) sound funny to me, I don't like singing them. These are all the places, he mixes them up in that song. They sing a different way over there (on the Karangura side, different from us Wangkangurru people).

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3. What the extra 'payment' was for the women was never made clear.
4. The geographic sequence of the Simpson desert wells was quite different from the order in which they are mentioned in the song. By this it is made clear that the Karangura man did not know the Simpson desert – it was not his country. Wangkangurru people relied on these wells except after rains and their location was well known to all the people in the desert. They first became known to Europeans as a result of the expedition of Lindsay in 1886 (see Hercus & Clarke 1986). The spelling of the names of wells given in the translation is that adopted by Lindsay. Murraburt was the westernmost of the wells, the one closest to Dalhousie, this is why Mick refers to it as 'the last Simpson desert water'. The location of *Karulinja* is not known.

29. He's speaking there in Wangkamadla about the History, naming whichever well they came from and wherever they went.
30. The old man resuscitated them. It was (at *Kutirinja*) in Karangura country that he said 'You come from Dalhousie'. Then the old man went on to Kuringala waterhole and from there to Dickerie, the (old) Alton Downs waterhole, where Jack Gaffney has his station.
31. The Two Boys went underground, they went following the (Eyre) creek, travelling to *Kira-ngarrapani* 'Making the boomerangs rattle' ('Herbert Hut'; see Fig. 7). They went together side by side with their mother walking behind them.
32. They went there to stay for a while at *Kira-ngarrapani-nha*, 'Making the boomerangs rattle' 'Herbert Hut'.[5] Ha, that is where the netting crosses through the Queensland border.
33. They must have been making the boomerangs rattle while they were singing. This is why the place is called *Kira-ngarrapani*, 'Making the boomerangs rattle'.
34. They stayed there for a while, making their boomerangs rattle at that place, far away. They had their own style of doing this, from Dalhousie, and they copied it in this place.
35. And that overflow there, what do you call that, the big swamp at Adria Downs? The Two Boys went there chasing the emus, ha ha![6] They turned back again to stay at *Kira-ngarrapani*, 'Making the boomerangs rattle', they must have been sleeping there I suppose.
36. Day after day they ran round chasing birds: they were killing birds to get all kinds of different feathers for the *Warrthampa*.
37. Then the two of them went up along the creek, following the creek they went. Their mother came along behind them carrying a coolamon full of water, carrying it like a canteen.
38. They went to *Kati-tharri*, 'Old Annandale'. *Kati-tharri* means headache in Wangkamadla.[7] *Kati-tharri*, Old Annandale that is Wangkamalda country, or Wangkamadla and Karangura mixed.
39. But nobody lives there now, it is empty country.

What Happened To Karangura People

The turmoil of early white settlement of the Birdsville area from the later 1870s onwards was an unmitigated tragedy for the Aboriginal people of the entire district. There were six major massacres, mostly well organised, and intended to wipe out whole groups of people. The immediate cause of these was cattle spearing, as in the massacre on the 'Georgina' (1) described by the solitary survivor, *Ngatu-thakali* (Hercus 1977), the massacre on the point of the Koonchera sandhill (2) (Hercus 1986) and the massacre at the Giri Giri waterhole (3). The murder of a lascivious station cook at Kooninghera near Durie on the Diamantina led to a series of revenge massacres throughout the region (Hercus & Jones, in prep.). These took place at Kooninghera itself (4), to the north at the Kalidawarry waterhole (5), and at *Mingka-ingkani* near *Ngapamanha* (6). There were lingering traditions even among white stockmen about these terrible deeds. This is clear from the evidence of Farwell (1950: 160) who estimated that at least 200 people were killed at Koonchera alone. There is hearsay evidence that the relevant police records were destroyed. Details of the Koonchera massacre were related to the next generation of Aboriginal people by the few survivors, by Charlie *Karna-piti*, who died about 1920, and by Kuranta 'Sticknest Rat' or 'Lagoon Charlie', Linda Crombie's grandfather, who died in his eighties in 1935. These survivors had been young men who were particularly skilful and able-bodied and therefore managed almost miraculous escapes. This fits with the probable date for these massacres, namely the late seventies and the early eighties of last century. In all these massacres Karangura people were among the main victims.

The events described by *Ngatu-thakali* (Hercus 1977) were a series of killings in which white horsemen, probably stockmen and not police, pursued Aboriginal people who had killed a bullock. They chased them from waterhole to waterhole on the lower Georgina, killing one small group after another, and also wiping out a larger group at the Narrabutiannie waterhole (Fig. 8). This must have been not long after 1878. In that year speculators first took up the part of the country which came to be called Alton Downs (Litchfield 1983:

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5. Reuther (Vol. VII: 845) gave the same explanation for this name:
   Kirrangaripini, Jelj.
   kirra = 'boomerang'; ngaripini in D [Diyari] ngaribana 'to beat time'. Meaning 'to beat time with boomerangs'.
   Wutjukana's son here beat time for the ceremonial *mura* song with boomerangs. The *muramura* therefore named the place accordingly.
   Wutjukana is the name that Reuther gives for the Two Men from the Initiation ritual centre at Mararu in the Simpson Desert.
6. In the earlier part of the myth the Two Boys had been chasing a pair of emus. They caught up again with the same pair of emus at Adria Downs and continued their pursuit.
7. A reference to this myth is to be found in an article by W. Fraser who lived for a while on Kaliduwarry near Lake Muncoonie. Fraser gives a summary of the story of the Two Boys and describes their chase of the Emus:
   they again followed up the tracks, which took them to a waterhole. They called this waterhole "Cuttitery" which means a sore head – for the boys had such sore heads there that they had to give up the chase. This waterhole is on the adjoining station to this. (Fraser 1899: 45)

FIGURE 7. *Kira-ngarrapani* 'Making the boomerangs rattle' waterhole, scene of major events in the Two Boys History of the Karangura. Photograph: L. A. Hercus.

FIGURE 8. Narrubutiannie waterhole, scene of a Karangura massacre in about 1880. Photograph: L. A. Hercus.

145), even before it had been surveyed. This station comprised practically the whole of Karangura country. *Ngatu-thakali*, who survived to tell the tale, was Wangkangurru, a member of a visiting group. The bulk of the people killed were local Karangura people.

A major massacre, often mentioned by Wangkangurru people, was at *Kiri-Kiri*, the Giri Giri waterhole of the maps. (Mick McLean always referred to 'the Karangura place Mikiri-kiri' as the site of this massacre, but he was probably influenced by the Wangkangurru word mikiri 'well'.) Oral traditions say that the killings were carried out by native police. One of this group of police was in fact a Lower Southern Aranda man, a classificatory uncle of Mick McLean (Tape 673):

> That was my uncle 'King George'. He was a policeman you know, and he went off shooting blackfellows in the Karlamuku country.[8]

According to oral tradition, the massacre at Koonchera was organised by police from Andrewilla and must have taken place around 1885 when police were first stationed there. This massacre and the vengeance parties that resulted from the murder of the cook at Kooninghera waterhole were by all accounts well organised: they appear intended to kill the maximum number of people, men, women and children. They seem timed to coincide with the major ceremonies, the *Mindiri* emu ritual and the *Warrthampa*. The massacre at Koonchera wiped out a large group of followers of the *Mindiri*. All the older Wangkangurru and part-Yarluyandi people who had heard about it in their youth, including Mick McLean, Maudie and Bob Naylon, Johnnie Reese, Dora Parker and Linda and Frank Crombie (Fig. 9), mentioned in their own accounts that many Karangura died there.

The massacres resulting from the events at Kooninghera, apart from the immediate action at Kooninghera waterhole, were organised to coincide with the *Warrthampa* rituals at Kalidawarry waterhole. This was the most important *Warrthampa* site belonging to the Wangkamadla, the immediate northern neighbours of the Karangura, and involved Karangura people. Another massacre eliminated a *Mindiri* group at the *Mingka-ingkanji* waterhole east of Pandie, adjoining Karangura country. There were said to be no survivors. This would again have involved Karangura people. Because they belonged to *both* the *Warrthampa* and the *Mindiri* traditions, Karangura people became victims of all the killings. By the late 1880s therefore, very few would have been left.

Apart from the organised massacres there were also private vendettas against Aboriginal people. A frontier attitude prevailed in the far north-east of South Australia and in the Birdsville area; this may well have cost some of the few remaining Karangura lives. The fragments of the Birdsville police records, made available by Angus Green, contain a particularly telling sequence of letters (Simpson Desert History Vol. 2). These are connected with a petition to the Colonial Secretary from the Diamantina Divisional Board on behalf of the residents of Birdsville in February 1887, during a drought, urging 'that the Blacks (Aborigines) and their dogs be removed from encampments on the township waterhole.' This was a very special place for Aboriginal people. Apart from being the deepest and most lasting waterhole in the district, it was *WirraRi*, an important Yarluyandi emu site, with rocks representing the ancestral emus. The police sergeant, the first ever to be stationed at Birdsville, an unsung hero named Sergeant A. McDonald, obviously did everything possible to avoid having to take the action

8. Karlamuku was used as a general term by desert Wangkangurru people to refer to the channel country to the east of their lands.

FIGURE 9. Linda and Frank Crombie, major sources of information on the Karangura and their traditions. Photograph: V. Potezny.

demanded of him by letters and telegrams from his superiors. He went from various delaying strategems to a straight refusal and managed to hold off the whole matter until it rained, when the Aboriginal people were prepared to leave in any case. This is clear from his lengthy letter from Birdsville to the Commissioner of Police, Brisbane, 27 September 1887. Some of his comments have sinister implications (Simpson Desert History, Vol. 2):

> About twelve months ago Mr Ward, Customs Officer here, observed a certain Squatter (a Justice of the Peace) on a Sunday illtreating the Blacks in their Camp and sent for a constable to give him in charge-this party is a member of the Board and no doubt would like to see the Blacks a long distance from the Town and the Police.

As a result of the killings the Karangura were reduced to a few survivors, some of whom lived at Andrewilla when Wells was there. From 1866 onwards many displaced people from the eastern Lake Eyre basin had sought refuge at the Killalpannina mission on the lower Cooper. According to the evidence of Mary Dixon and other elderly Diyari people who had been at Killalpannina at the turn of the century only two old Karangura people were at the mission at that time and they died soon after.

Conclusion

We must conclude from this that the Karangura ceased to be mentioned in the literature quite simply because they had been wiped out. Nobody lives now in what was their traditional heartland, along the channels of the Georgina. The old Alton Downs homestead is deserted; the new homestead, the only habitation in the whole of Karangura country, is at the Andrewilla waterhole. It is truly 'dead men's country', but it is also country that once had a rich tradition of mythology, now vanished.

Note on Orthography

In this paper a practical orthography has been used for Wangkangurru:

Plosive consonants other than the retroflex plosive have been written as unvoiced (*k, p, th, t*), but pre-stopped consonants have been written with voiced plosives as this corresponds most closely with the pronunciation, hence *bm, dn, dnh, dnj, dl, dlh*.

Retroflexes have been written as *r* + consonant, i.e.

rl is retroflex *l*
rn is retroflex *n*
rd is retroflex *t*

Interdentals have been written as consonant + *h*, hence *nh, th, lh*.

Palatals have been written as consonant + *j*, hence *tj, nj, lj*.

ng has been used for velar *n*.

The three r-sounds have been transcribed as follows:

r = the alveolar flap
rr = the trilled r
R = the retroflex r.

Glosses

The following abbreviations used for linguistic terms are used in glossing Wangkangurru texts:

ABL	ablative case
ACC	accusative case
ACT	active stem-forming suffix
APP	applicative stem-forming suffix
CAUS	causative case
CONT	continuous participle
EMPH	emphatic clitic
PURP	purposive
ERG	ergative
HIST	historical past
IMP	imperfective
IMPV	imperative
LOC	locative case
NAR	narrative past
PAST	past tense
POS	possessive suffix
PUNC	punctiliar present
SP	speed form, indicating action undertaken before departing
TR	transitory aspect

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OCCURRENCES OF *PALORCHESTES* SPECIES (MARSUPIALIA: PALORCHESTIDAE) IN SOUTH AUSTRALIA

NEVILLE S. PLEDGE

PLEDGE, N. S. 1991. Occurrences of *Palorchestes* species (Marsupialia: Palorchestidae) in South Australia. *Rec. S. Aust. Mus.* 25(2): 161–174.

The first discovery of *Palorchestes azael* in South Australia was made in about 1870 in a clay pit near Adelaide. Although reported briefly by Tate, it has not been described in detail until now. Several discoveries in the past twenty years have enlarged our knowledge of the genus, expanding its geographic and stratigraphic range in the State, and increasing its taxonomic diversity. *Palorchestes azael* including previously undescribed anterior cheek teeth, is now reported from Naracoorte in the South-East. A second, small Pleistocene species has been found near Mt Gambier and is compared with *P. parvus*, and the late Miocene *P. painei* is reported from a cave deposit on Yorke Peninsula.

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Palorchestes azael (Owen, 1874, 1875, 1880) is one of the rarer elements of the Pleistocene marsupial megafauna. Alone amongst the diprotodontoids (Archer & Bartholomai 1978), the teeth of *Palorchestes* are characterised by a mid-link between the two loph(id)s, to such an extent (with other characters of the palate) that Owen (1874) and others considered it to be a giant kangaroo. Woods (1958) showed that *Palorchestes* was not a kangaroo but more akin to the diprotodontids. Other features of the skull have since indicated *Palorchestes*' distinction from the Diprotodontidae (Archer & Bartholomai 1978).

The type specimen of Owen's *Palorchestes azael* (1874) was obtained from an unspecified deposit in Victoria in 1851. This was probably on the River Tambo in Gippsland (Mahoney & Ride 1975: 88). Lydekker (1887) listed it and three other specimens as being in the British Museum (Natural History); one of the latter came from the Wellington Caves, New South Wales, and the other two from the Darling Downs of Queensland. In his revision of the genus, Woods (1958) listed only nine specimens of *P. azael* from the eastern Darling Downs, then in the Queensland Museum. Ramsay (1886) reported *P. azael* (as a new species *P. rephaim*) from the Wellington Valley and Dun (1893) reported further occurrences of the species in the caves there. Scott (1916) recorded it in the Mowbray Swamp deposits of Tasmania, Gill & Banks (1956) from the Scotchtown Cave, in the same area, and Gill (1953) from Terang, Victoria. Dennant & Kitson (1903) had earlier listed two specimens from Werribee and Sorrento in Victoria, while Flannery & Archer (1985) mention it as occurring also at Strathdownie, Spring Creek and Buchan Caves in Victoria. Glauert (1926) reported it from the Margaret River caves of Western Australia, but Merrilees (1968) discounted it. Finally, *Palorchestes* sp. *cf. P. azael* is listed for the Tirari Formation along the Warburton River near Lake Eyre in northern South Australia (Wells & Callen 1986), and has recently been found at Riversleigh, Queensland (Davis 1990). The species appears to be widespread, as indeed is *Diprotodon*, but *Palorchestes azael* is rare by comparison. Its ancestors may not have been so rare. *P. parvus* is a not uncommon member of the Chinchilla local fauna (De Vis 1895, Woods 1958), and is reported to occur with *P. azael* at Strathdownie, Buchan Caves, Wellington Caves and Gore (Queensland) (Flannery & Archer 1985), while the earlier *P. painei* is found at Alcoota (Woodburne 1967), and also at Hamilton (Turnbull & Lundelius 1970). Recently, postcranial material with associated teeth has been found (Flannery & Archer 1985) allowing determination of other bones and tentative reconstructions.

Specimens of *Palorchestes* spp. are here described from four South Australian localities of different ages. Evidence is presented for a second (and possible third) Pleistocene species, after *P. azael*, with deciduous teeth being described for the last, while the presence of the late Miocene species *P. painei* is indicated. The localities for the specimens described are shown in Fig. 1.

Material studied is housed in the South Australian Museum (SAM), Queensland Museum (QM), Australian Museum (AM) and the National Museum of Victoria (NMV). Tooth designation follows Archer's (1978) system which is based on embryological studies of modern marsupials.

Thebarton Specimen (SAM P11546)

The first record of *Palorchestes azael* from South Australia was a mention in passing by Tate (1890). In about 1889–90 Mr W. Shearing presented to the South

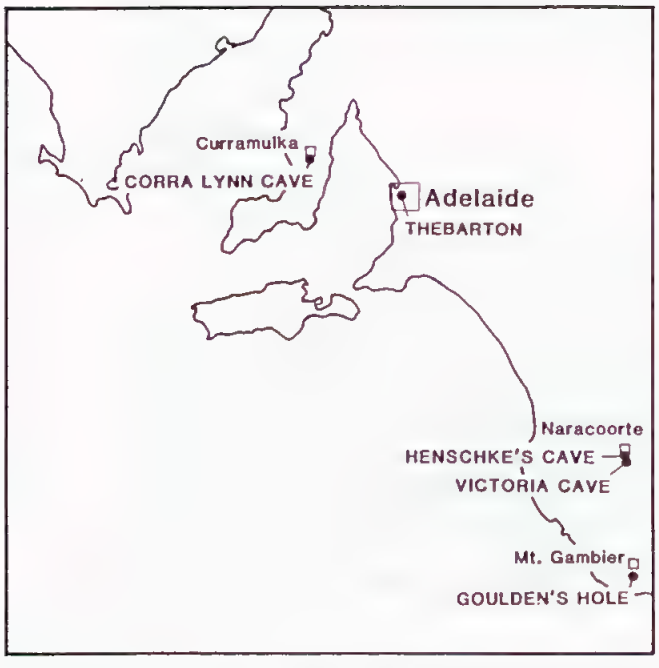

FIGURE 1. Locality map showing finds of *Palorchestes* spp. in South Australia.

Australian Museum two jaw fragments that had been found in about 1870 some 5 metres below the surface in his clay pit at Thebarton, then an outer suburb about 2 kilometres west of the city of Adelaide. The exact locality has been lost and the pit probably filled in and reclaimed. Occasionally bones were found in the numerous clay and sand pits west of Adelaide, usually *Diprotodon* (Tate 1890: 182) in various stages of disintegration, but the specimens described here are somewhat better preserved.

Material

This comprises the fused symphyseal portion of the mandibles, with evidence of the premolar and three molars (M_{2-4}) in the right ramus, and M_2 in the left jaw (Fig. 2). The anterior extremity of the symphysis is badly damaged, and much is missing. The teeth are badly chipped and greatly worn. The premolar is represented only by its roots, while of the molars, only M_3 retains any trace of enamel. M_2 has been worn to or below the base of the enamel. Nevertheless, approximate measurements can be made of M_2 and

TABLE 1. Dimensions of upper molars of *Palorchestes* spp. (in mm).

Specimen	M^2	M^3	M^4	M^5	Comments
P. azael					
BM (NH) 46316	24.1×19.6	25.4×21.2	25.7×20.3	27.1×22.7	from Woods (1958)
AM F7272 (=B.5936, type of *P. rephaim* Ramsay)	25.5×21.2 25.0×21.0	27.0×23.5 26.8×23.2	27.2×23.7 27.2×22.5	28.0×22.0 28.0×21.5	from unpublished scaled photograph
QM F773 "	26.0×22.3 26.1×21.8	26.5×23.2 26.7×22.7	26.7×22.6 27.8×22.6	28.5×21.3 27.6×22.0	from Woods (1958)
QM F3837				28.7×25.3	pers. comm., M. Archer (1973)
SAM P11546		26.0×24.0e	27.0×24.0e		e = estimated
P. parvus					
QM F789 "	18.8×14.7 17.8×14.2	20.3×16.1 20.6×16.2	21.2×16.3 21.3×16.5	24.0×16.7 23.3×16.6	from Woods (1958)
P. painei					
CPC6752	18.2×14.3	–	18.0×15.3	18.6×14.4	
UCMP 70553 (left)	16.8×14.4	18.1×15.5	19.4×16.3	20.1×15.6	from Woodburne (1967)
UCMP 70550	16.7×13.9	18.0×15.3	18.5×15.0	20.2×15.5e	e = extrapolated measurement
UCMP 66521	17.8×14.0	18.0×15.5e	18.0×15.5e	19.9×15.5e	

M_3 (Table 2). The other fragment represents part of the right maxilla, with M^3 and M^4. Again, the teeth are very worn and broken, but M^4 retains some enamel labially, and approximate measurements are possible. The size of these teeth agree with those of *Palorchestes azael* (Table 1).

Description

Mandibles. Although somewhat crushed laterally, and preserved in partly calcified clay which makes preparation difficult, the mandibles have been partially restored, particularly in order to eliminate the distortion in the symphyseal region, and to complete as far as possible the anterior portion of the right ramus. Unfortunately, the end is a mass of hardened calcific clay and cancellous bone that does not lend itself to cleaning. As a result, the full symphyseal length, and the nature of the incisor alveolus are unknown; indeed, there is no sign of the incisor. The left molar is slightly displaced linguad but this was not considered important enough to risk damage to the specimen by restoring it to its proper position.

As Woods (1958) states, the diastema is long (at least 85 mm) and the diastemal crest descends forward from the premolar position on the dorso-lingual side of the ramus. The mandibles are firmly fused, with no trace of a suture. The preserved part of the symphysis is 145 mm long, ending level with the anterior root of M_3. The lingual region of the symphysis is a deep, rounded groove. At the level of the anterior mental foramen, 40 mm anterior to M_2, the width of this lingual channel is the same as the depth, approximately 22 mm. Below M_2, a large (11 mm diam.) sub-circular genial pit straddles the symphysis. The posterior end of the symphysis is sharply rounded, forming a transverse torus 18 mm thick. Ventrally, the mandible appears narrow and attenuated. About 50 mm in front of the posterior edge of the symphysis and about 30 mm apart, are two broad shallow depressions on either side of the midline. The effect of these is to produce a slight carination of the symphysis. The mental foramina are 25 mm antero-dorsal of these depressions. Indication of a very small posterior mental foramen is seen 40 mm below the anterior root of M_3. The mandibular canal below M_4 is 14 mm high and 11 mm wide.

Maxilla. Only the portion giving rise to the right zygoma, with the remains of two molars, is preserved. The zygoma arises opposite M^3, as in Owen's specimen (1874, pl. LXXXII). M^3 is represented only by dentine and roots, but M^4 retains some enamel labially. This is smooth and mostly lies in the protection of the transverse valley.

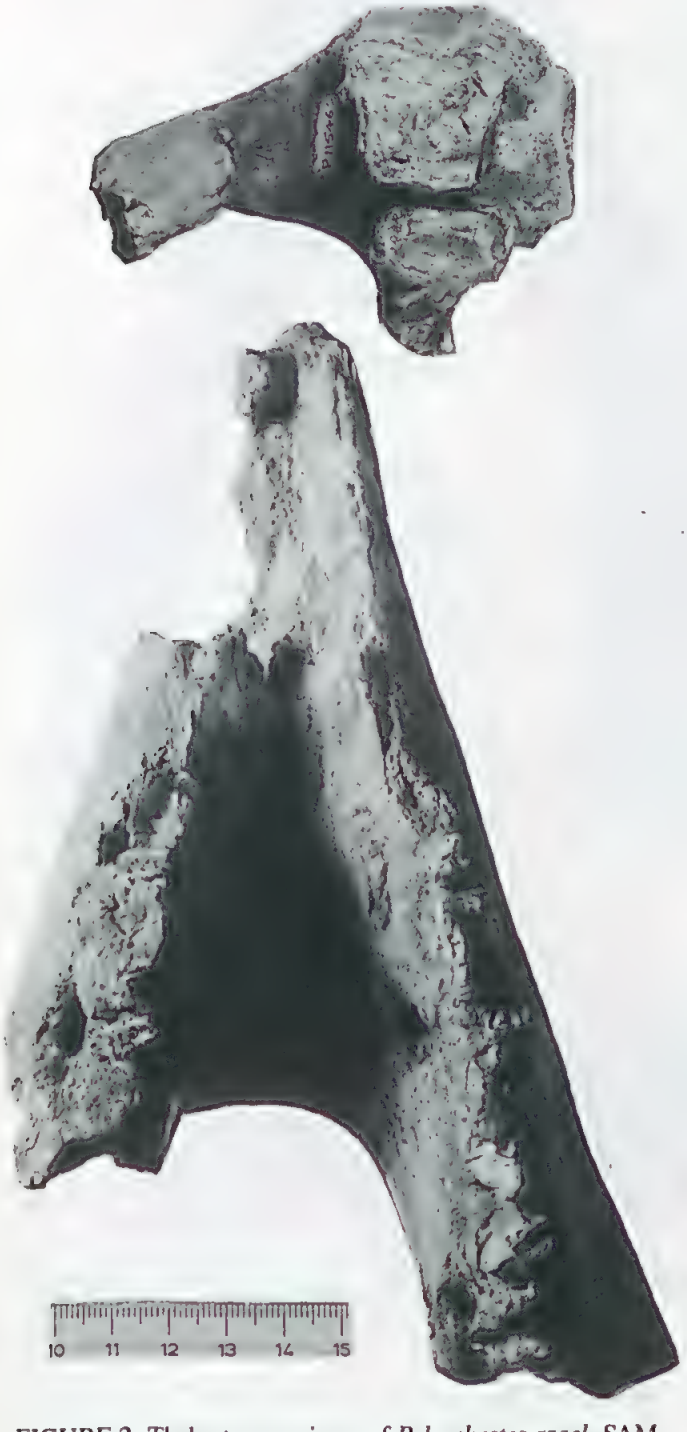

FIGURE 2. Thebarton specimen of *Palorchestes azael*, SAM P11546, dentaries and maxilla fragment. Scale in mm.

Geological Age

The precise geological age of the specimen cannot be determined as no carbon-dateable material was obtained. The clay deposit at Thebarton has been identified as probably the Pooraka Formation of Firman (1969), which consists of up to 7 metres of late Pleistocene sandy clay overlying the older Pleistocene Hindmarsh Clay.

Victoria Fossil Cave Specimen

Early in 1972, during excavations conducted by R. T. Wells in the Victoria Fossil Cave, Naracoorte, the large mandibles of a *Palorchestes azael* (SAM P16583) were unearthed (Wells *et al.* 1984). Certain other large bones (mainly limbs) have been found in the same area,

TABLE 2. Dimensions of lower molars of *Palorchestes azael* (in mm).

Specimen	M_2	M_3	M_4	M_5	Comments
P. azael					
BM (NH) M34 (type of *P. crassus* Ow. 1880)	26.5×15.0	27.0×16.0	30.0×17.5	(33×22)	from scaled photograph of original. (Left ramus). Owen (1880) figured the other ramus.
BM (NH) 40034	22.7×16.1	27.1×17.8	29.4×20.0	–	from Woods (1958)
QM F774	23.4×14.7	28.5×17.7	27.6×18.0	–	from Woods (1958) with estimate for M_4
"	22.4×13.3	28.2×17.7	27.2×18.0	–	
QM F781	23.7×15.6	27.2×17.0	–	–	from Woods (1958)
SAM P11546	24.1×14.0	25.7×16.0	(28)×17.0	–	estimated from battered specimen
SAM P16583	24.8×17.2	–	29.0e×21.0e	29.6×21.2	
"	24.5×17.4	26.7×18.8	28.5×20.4	30.9×20.2	

and may belong to this specimen. So far, no skull has been found.

The Fossil Chamber of Victoria Cave is a large tunnel about 60 m long, and up to 15 m wide, with a maximum of about 2.5 m headroom above a silt floor up to 3 m thick, with bone scattered throughout (Wells 1975, Wells *et al.* 1984, Smith 1971). The *Palorchestes* specimen (SAM P16583) was collected by Wells in the top 15 cm near the south-western wall about halfway along the tunnel (excavation grid reference: 70–70.5 R8′–9′ D0–6″).

Material

The specimen consists of the fused mandibles, with more or less complete cheek-tooth rows (the left M_3 and half of both LM_4 and RM_4 are missing), and with enough of the ascending rami to indicate most of the form (Fig. 3). The coronoid processes are both missing, as are the spatulate incisors. The jaws are well preserved; the teeth were fractured and expanded by infiltrating silt, but the pieces have been cleaned and rejoined with little distortion or alteration from their original size and form. A few expanded cracks in the jaws have been left unrepaired as they do not materially affect any measurements. The specimen is considered to be the best preserved of all those so far discovered.

The best preserved *Palorchestes azael* previously reported is QM F774, from a well on the Darling Downs in Queensland (De Vis 1884; Woods 1958). In that specimen of a juvenile individual, the jaws are pathologically deformed (parameral differentiation), lack most of the ascending rami, and have the teeth fractured, expanded and recemented so that accurate measurements are not always possible. It does, however, retain the scoop-like incisors and possess all molars, although the M_5s had not yet erupted.

Description

The jaws of the Naracoorte *Palorchestes* are basically similar (so far as can be compared) to the Thebarton mandible fragment and also to QM F774. The only noticeable difference is the absence of the genial pit in the lingual channel. Certain anatomical features can now be described in full: most importantly, the length of the diastema is 114 mm and the total length, from anterior tip of the symphysis to the condyle is 425 mm. The symphysis is 178 mm long. The anterior mental foramen is 87 mm from the tip of the mandible and 47 mm from P_3. At the posterior edges of the alveoli of the incisors, the jaws are about 48 mm wide and 34 mm deep. At the anterior mental foramina, these dimensions are 46 mm and 52 mm (minimum transverse distance) respectively, and at P_3 78 mm and about 70 mm. The depth of the mandible at M_2 and M_5 is 76 mm and 65 mm respectively, with a ramus thickness of 46 mm at M_5. Because of damage or loss to one or other ramus (*e.g.* only one condyle is preserved), the maximum width of the jaws cannot be measured, but an estimate is given by the maximum separation of the pterygoid fossae: 205 mm. Separation

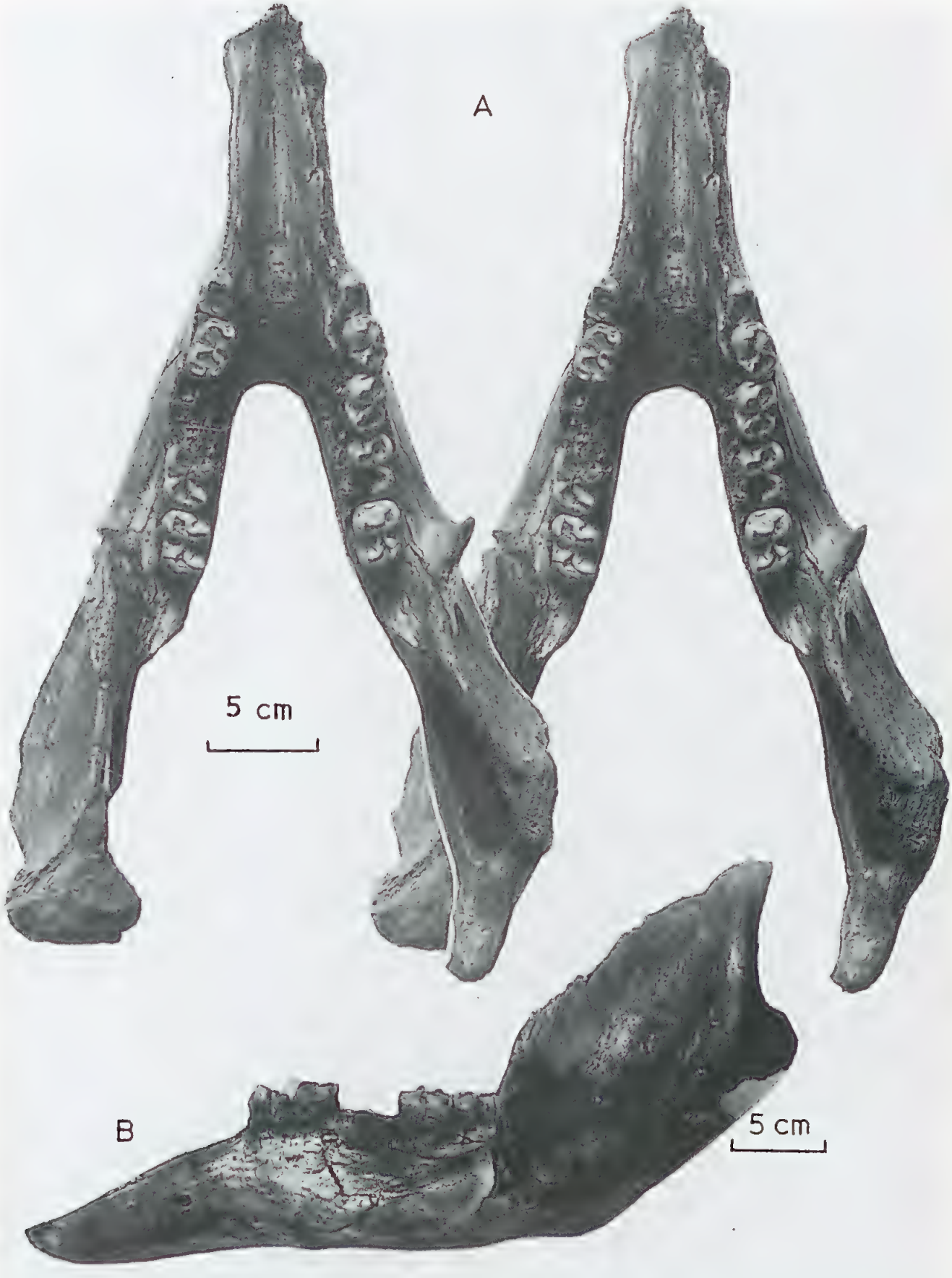

FIGURE 3. Victoria Cave specimen of *Palorchestes azael*, SAM P16583, A) dentaries in occlusal view (stereoscopic pair), B) left dentary in profile.

of the tooth rows is as follows: 43 mm at P_3, 45 mm at M_2, and about 40 mm at M_5.

In profile, the jaws are outstanding amongst the diprotodontoids, and are reminiscent of the macropodines. The predental portion is flexed downwards rather like *Macropus giganteus* and the incisor alveoli suggest the scoop-like teeth seen in QM F774. The ascending rami tend to slope backwards as in *Bettongia*, rather than rising vertically as in *Diprotodon*, *Zygomaturus* or *Macropus*. With the jaws resting on a flat surface, the height of the condyle is 195 mm. Both coronoid processes are missing, so the total height is unknown. The masseteric fossa is shallow, as is characteristic of diprotodontids, but sharply bounded and ovate. The pterygoid fossa is deep, bounded below by an upturned lip. The angular process is prolonged acutely, and directed somewhat medially. The post-alveolar shelf is separated from the ascending ramus just posterolabial to the M_5 by a thin high wall that forms a distinct rounded trough about 15 mm in diameter.

The alveolus for the incisor is roughly crescentic or reniform in section, concave dorsomedially, and tapers rapidly with a depth of only a few centimetres. The maximum diameter of the alveolus is 23.3 mm and the minor diameter is about 13 mm. The alveoli are oriented such that the incisors may be splayed a little. The cheek teeth, being worn down to the dentine and breaching the links in all molars, indicate a mature age for the animal. By contrast, the Thebarton specimen, SAM P11546, was aged and QM F774 juvenile. The enamel of the teeth is consistently smooth, though this may be due to food abrasion. The form of the teeth is the same as described by Woods (1958). Tooth-row lengths are 134 mm (left) and 130 mm (right); LP_3 is 19.4 mm × 14.5 mm, RP_3 is 19.1 mm × 14.7 mm. Other dimensions are given in Table 2.

The similarity in form of the jaws to those of some of the early 'shovel-tusker' proboscideans (*e.g. Phiomia*, see Osborn 1936) suggests a similar habit, though the analogy should not be carried too far. It should, however, be noted here that the form of the nasal region as seen in BM(NH) 46316 (the holotype of *P. azael*, Owen 1874: 83), QM F789 (*P. parvus*) and QM F91719 (*P. painei*) indicates a long, regressed nasal opening (Bartholomai 1978), such as is found in *Phiomia* and also in tapirs, and therefore the likelihood of a short trunk. This has been accepted in recent restorations (*e.g.* Flannery 1983, Flannery & Archer 1985). Such a feature has also been suggested for the diprotodontids *Zygomaturus* (Scott 1915), and *Diprotodon* (Rich 1983).

Geological Age

Uranium series and collagen racemisation dating of bone from the upper levels, which yielded this specimen, have given the results: 125 000 U/Th and 150 000 years U/Pa BP (H. Veeh in Wells *et al.* 1984) and 50 000 and 70 000 years BP ± 20% (J. Bada in Wells *et al. ibid*) respectively. Carbon dating of associated charcoal gave results of about 16 700 years BP (+ 3000, − 2180) (*ibid.*), suggesting a lag deposit with reworking (*e.g.* Archer 1974).

Henschke Fossil Cave Specimens

During the early-mid 1980s, excavations by J. Barrie in the newly uncovered deeper sections of the Henschke Fossil Cave (Barrie 1990, Pledge 1990), on the outskirts of Naracoorte, produced a number of isolated teeth of *Palorchestes azael* (Fig. 4).

The teeth are mostly from two areas in the cave, and can be distinguished by their colour/preservation. Most are from the area 'HJD' (Barrie 1990) in a reddish silt (specimens SAM P31364, 31365, 31368, 31376, 31378–31380) and show generally a darker brownish preservation, while a few were collected several metres away at area 'HSDW' in a sandier sediment and have a buff to cream colour (SAM P31377, 31381–31383). Several others were found in the intervening area (SAM P31355) or elsewhere in the cave (SAM P31367, 31384) and also show pale coloration.

Material

This comprises a pair of I^2, a second damaged LI^2 and RI^2, a pair of P^2 (one still in a fragment of maxilla) a right M^1, a pair of M^2, a pair of M^3(?), two fragmentary left I_1, a right I_1, right M_1 and fragment of left M_1, left M_2(?), non-identical left and right M_3(?), and the anterior half of a more posterior(?) molar. All the teeth are only barely worn, the enamel crests cracked rather than worn through, and it is apparent that at least two individuals were present. It is also apparent that there is some considerable morphological variation, at least in the lower molars and lower incisors. Because the teeth are so near to pristine condition, as compared with published material, they are described briefly below.

Description

I^2(?) (SAM P31364–31367). There is some uncertainty about this designation which is based on comparison with *P. parvus* (QM F789). The tooth is relatively broad (13 mm), strongly curved, and very thick (>10 mm) at the base where the cross section is trapezoidal. The cutting edge, slightly uneven, is at about 75° to the longitudinal axis, acute medially. The teeth are very similar to the otherwise very worn AM F2451.

P^2. (SAM P31368, 31369). A pair of premolars is given this designation. One of them is the only specimen in this collection to have any associated bone, and this preserves what is considered to be part of the crypt for the unerupted left P^3. In addition, the teeth are much smaller, and of different detailed morphology, than P^3 of *P. azael* (AM MF 452) from Wellington

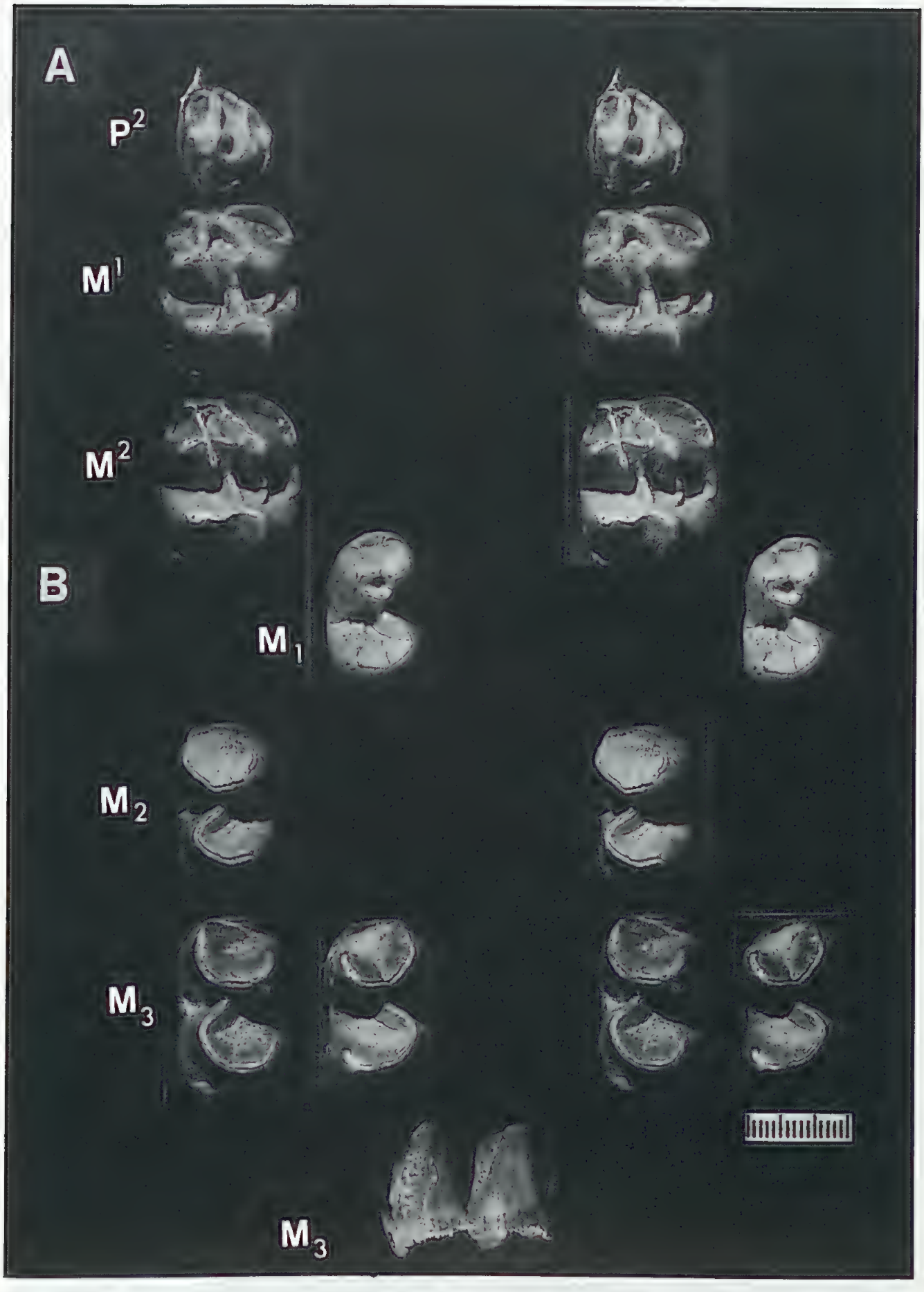

FIGURE 4. Henschke Fossil Cave specimens of *Palorchestes azael*. A) Right upper teeth, occlusal view in stereo; P^2 (SAM P31368), M^1 (P31370), M^2 (P31371). B) Lower cheek teeth, occlusal views in stereo; right M_1 (SAM P31381), left M_2 (P31369), left M_3 (P31379), right M_3 (P31378, also in medial profile). Scale in mm.

Caves. However, they closely match in size and morphology the P^3 of *Palorchestes parvus* (QM F789). They are marginally larger than that specimen and almost unworn, thus preserving the crests in great detail. (There is no other evidence of *P. parvus*, such as molars, in the deposit, and with the evidence of the P^3 crypt, the premolars are confidently referred to *P. azael*.)

The teeth are roundly triangular, the shortest side anterolingual and bearing a well defined precingulum. The longitudinal crest extends from the parastyle to a point about 2 mm lingual of the posterior corner. The metacone is about halfway along the crest and is the highest cusp. The paracone is close in front of it, and sends a deeply notched transverse crest lingually to the protocone. A parallel crest from the metacone towards the hypocone ends abruptly at a deep notch and does not meet a weak crest from the poorly expressed hypocone. A low postcrista from the protocone includes the swelling of the hypocone and continues, parallel to the longitudinal crest, to meet the posterolingual cingulum at about the halfway mark. The posterobuccal corner of the tooth is shallowly basined by the longitudinal crest, the posterobuccal cingulum and the swelling of the combined protocone-hypocone.

A damaged tooth (P31384) from a different part of the cave (HJDX) somewhat resembles in general form the teeth mentioned above. It differs in being slightly larger and in having a more complicated zig-zag longitudinal crest. The posterior moiety is similar but from the paracone(?), separated from the metacone by a notch in the crest, the crest forks into an anterior and a buccal branch, the latter not quite reaching the buccal cingulum. It is concluded that this tooth is an aberrant right P^2 rather than P^3 since it in no way resembles the P^3 of AM F452.

M^1. One tooth (SAM P31370) may represent this position. It is from the same locality in the cave as the pair of M^2s described below, but is of more solid appearance, shows slightly greater wear and some morphological differences. It generally resembles (as do the M^2s described below) the M^2 of QM F772, but differs in having converging rather than parallel forelinks from the paracone and protocone, the preparacrista being aligned longitudinally. Also there is a sharp postparacrista which converges on a slightly weaker premetacrista, and a stronger premetaconulecrista that meets the postprotocrista. In addition there is a weak postmetacrista which impinges on the postcingulum.

In view of the decreasing development of links and crests backwards in the upper molar tooth row, this hyperdevelopment of crests suggests that SAM P31370 is indeed an example of M^1. It should be noted that QM F772 preserves the posterior margin of an alveolus anterior to M^2, as well as trace of a crypt below it. Since AM F452 indicates that P^3 erupted when M^2 was quite worn, the crypt in QM F772 apparently housed P^3 which means that the alveoli above it contained M^1 of similar size to the little worn M^2

M^2. This position is represented by a pair of teeth (SAM P31371 [right] and P31372 [left]) from the same area, exhibiting identical preservation and stage of wear – virtually unworn. The teeth resemble QM F772 (Woods 1958: fig. 1 – his M^1) except that the two forelinks from the paracone and protocone are convergent instead of roughly parallel, and the postparacrista is somewhat sharper. They also resemble the putative M^1 (SAM P31370) except in lacking the premetacrista and the postmetacrista and having a weaker post-protocrista-premetaconulecrista link.

M^3. Except in being less worn and very slightly larger, the teeth ascribed to this position, (SAM P31373 [right] and P31374 [left]), are identical to M^3 of QM F772.

I_1. Three specimens represent this tooth: a fragment of left incisor (SAM P31377) and a pair (P31375 – incomplete left, and P31376 – complete right). They are virtually unworn and are interesting in showing a distinct dorsal crest ('dorsal flange' of Woods 1958) extending from the tip, posterobuccally just inside the outer edge of the tooth, for almost half the length of the enamel crown.

The tooth P31376 has the typical spoon-shape of *Palorchestes* spp. with a thicker, straighter medial margin and the anterior extremity on the mesial side. However, it differs noticeably in proportions from that of QM F2203 from Dalby, Queensland, being absolutely shorter and broader than that somewhat worn specimen. It has, in fact, the same breadth: length proportions (0.61) as that of *P. parvus* (QM F7072 from Chinchilla, Queensland), whereas the ratio for QM F2203 (*P. azael*) is less than 0.4.

M_1. Comparison of the six lower molar specimens suggests that two are in fact deciduous first molars. SAM P31381, a complete right molar, and P31382, an anterior fragment of the left, show similar preservation and stage of wear and are from the same locality (area HSDW) in the cave. They show the same unique structure that differentiates them from typical *Palorchestes azael* lower molars, a feature not previously reported in *Palorchestes*, yet reminiscent of first molars in some other diprotodontans, namely the retention of the trigonid. Instead of a simple protolophid, there is a triangular structure having the protoconid and metaconid at the ends of a narrow transverse protolophid, and these joined by lower cristids to an equidistant lower point at the end of the cristid obliqua. There is thus a deep enamel-lined basin or pit forming the 'stop' of a question mark formed by the cristid obliqua and concurrent hypolophid. Because of the apparent lateral compression of protolophid, there is a strong preprotocristid and premetacristid. The precingulum is strong and high, but unaffected by these cristids. The postlink of the hypolophid is

almost undetectable – just a slight swelling at the apex of the broad postcingulum. This postcingulum is slightly broader and definitely higher than in succeeding molars, and is seen to decrease in height to a low eminence in the M_5 of other specimens, *e.g.* SAM P16583.

Despite the triangular form of the protolophid, it cannot be interpreted as a trigonid without radical reinterpretation of the cuspid pattern of the lower molars, since the triangle is apparently headed in the opposite direction to a normal trigonid. Too few diprotodontan M_1s are preserved in a state of little or no wear for detailed comparative studies to have been made. In the primitive diprotodontid *Raemeotherium yatkolai*, M_2 possesses a small but distinct trigonid (Rich *et al.* 1978), but this cannot be reconciled with the *Palorchestes* molar unless the posterior corner of the triangle in the latter is considered to be the protoconid, which makes the buccal corner the paraconid. It would be tempting, if there were just one such tooth, to dismiss it as dental anomaly – a possibly pathological condition (Archer 1975). But with a second specimen mirror-imaging the first, and probably from the same animal, this is not so easy to accept, although symmetrical abnormalities are recorded (*ibid.*).

On balance, it is proposed that these two specimens do represent M_1 of *Palorchestes azael*.

M_2. Comparing the three remaining complete molars, from two localities, it is apparent that only one (SAM P31383) represents M_2, and it is from the same site as the putative M_1s, having the same preservation. It is slightly longer than M_1 and has a slightly lower postcingular eminence. Otherwise it has the typical form of a lower molar of *Palorchestes azael*.

M_3. Two teeth, SAM P31378 (right) and P31379 (left) are allocated this designation. Although from the same location (HJD) and having similar preservation, size and stage of wear, they are not considered to be a pair because of a distinctive postmetacristid on the left molar, which is repeated on the anterior moiety fragment of the proposed M_4, SAM P31380. This cristid forms a strong fork at the lingual end of the protolophid. Again, this feature could be considered an anomaly, possibly similar to the split cusp phenomenon recorded by Archer (*idem*), but its repetition in successive teeth in the jaw suggests a more regular feature.

M_4. SAM P31830 is the broken anterior moiety of an unerupted molar – evinced by the open-prismatic nature of the enamel, not yet fully calcified. As noted above, it displays a distinct postmetacristid.

Discussion

At least two individuals referrable to *Palorchestes azael* are represented here (Table 3). One of them is represented by both upper and lower teeth, whilst the other seems to have been just the lower jaws. Both were immature animals. Features of the M^2, I_1 and possibly M_2 call to question the specific allocation of the taxon because these teeth are noticeably different from those reported in accepted *Palorchestes azael* specimens. However, on present evidence, it is only possible to indicate that there may have been great variation in the

TABLE 3. Cheek tooth dimensions (in mm), *Palorchestes azael* from Henschke Fossil Cave.

Tooth	Specimen no.	Length (l)	width	protoloph (id) height (h)	h/l
P^2 (L)	P 31368	17.1	14.0	10.0 (pa-me)	0.58
(R)	31369	16.8	14.0	10.6 "	0.63
(L)	31384	17.5+	14.5	10.8 "	0.62
M^1 (R)	31370	28.1	22.5	14.5	0.52
M^2 (R)	31371	28.7	22.8	15.0	0.52
(L)	31372	28.5	22.6	15.0	0.53
M^3 (R)	31373	29.9	24.0	18.5	0.62
(L)	31374	30.0	25.4	18.2	0.61
M_1 (R)	P 31381	26.3	16.4	20.2	0.77
(L)	31382			20.0	
M_2 (L)	31383	27.5	17+	20.8	0.76
M_3 (R)	31378	28.6	17.4	19.9	0.70
(L)	31379	28.9	18.0	20.2	0.70
M_4? (L)	31380	–	17+	–	–

species. The features have not been reported before because most described specimens are of older individuals whose teeth are worn to the point of destroying detailed cusp morphology.

It should be noted that an unworn specimen of *P. cf. painei* from Hamilton (Turnbull & Lundelius 1970, pl. *xxx*) seems to show an incipient postmetacristid, as in SAM P31379.

Age of Deposit

Only two radiocarbon determinations have been made on the Henschke Cave deposits, both from the upper beds of the upper part of the cave (Pledge 1990). They gave a result of about 37 800 years BP for the depth interval 30–75 cm and greater than 35 000 years BP for 105–120 cm.

The *Palorchestes* teeth come only from the lower part of the cave (Barrie 1990) and are considered to be much older.

Gouldens Hole Cave

Gouldens Hole is a cenote several kilometres south of Mt Gambier in the far south-east of South Australia. Uncovered by a farmer's excavation of an access ramp to the water, there is a small simple tunnel, which gradually slopes up and away from the sinkhole. The floor of this tunnel was covered to about 15 cm with a silty deposit containing fossils. These consisted primarily of isolated teeth, but with occasional bones of modern vertebrates mixed with them as well as invertebrates dissolved out of the Gambier Limestone. The deposit thus contains a mixed vertebrate fauna ranging from (?middle) Pleistocene to Modern (such as sheep and rabbits, therefore post 1858). The end of the tunnel cannot be reached because it narrows too much, but it is apparent that the fossils are derived from a distant (and filled-in) entrance by water-winnowing of a debris pile. Virtually only small (teeth) or light (modern bones) specimens reached the lower extremity of the tunnel.

Material

Amongst the collection representing at least ten marsupial taxa are five and one half molar teeth of *Palorchestes* sp. (Fig. 5) – a pair of upper molars M^2 (P24097), a left and right M_2 (not a pair – P31396, P31397), a larger right lower molar (P31399) and half of a similar (but more anterior) tooth (P31398).

Description

These teeth are about the size of *P. parvus* molars, although possibly exhibiting greater size variation, but appear to be higher crowned than comparative topotypic material at hand (see Table 4). The upper molars are smaller and relatively narrower than that

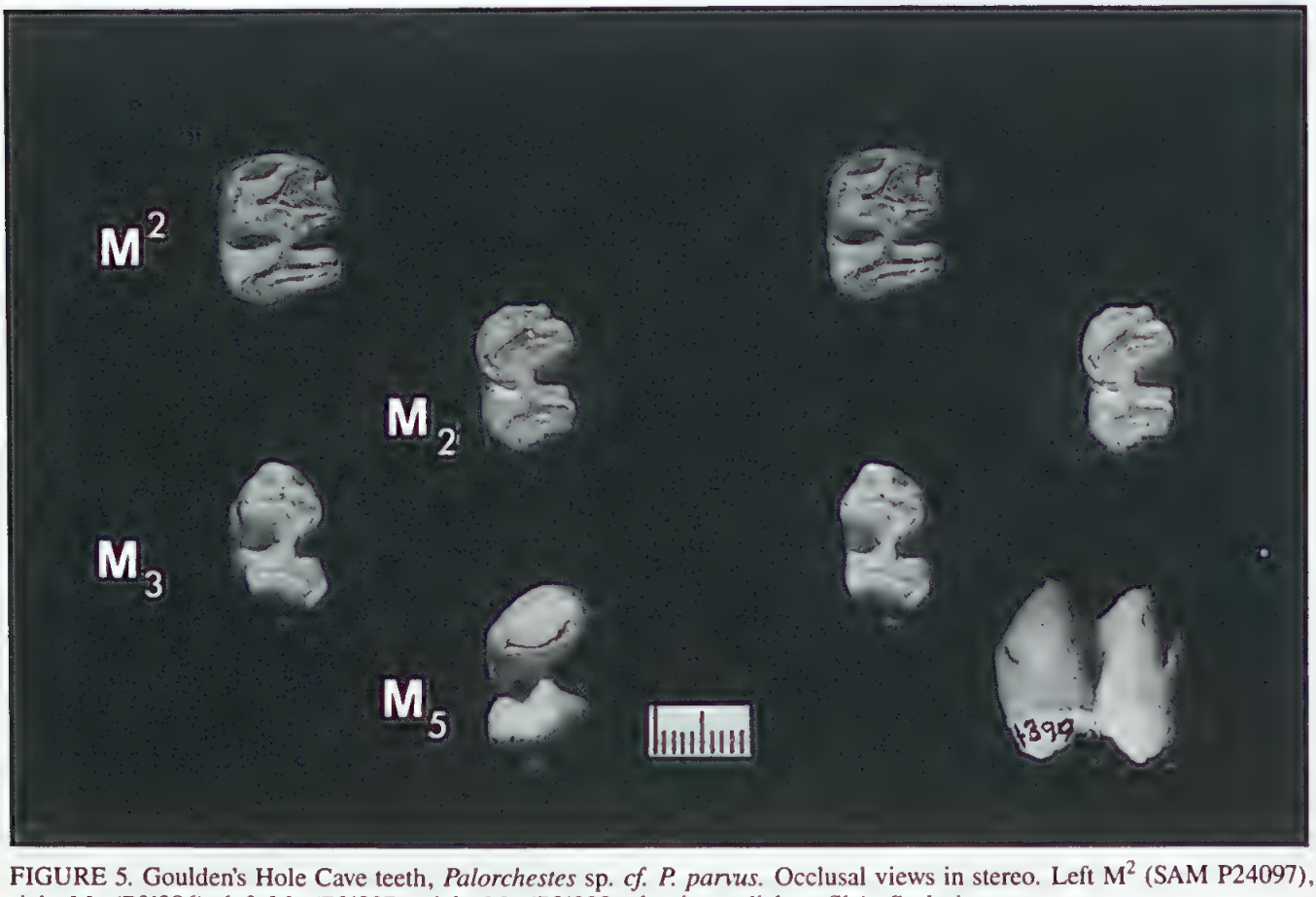

FIGURE 5. Goulden's Hole Cave teeth, *Palorchestes* sp. *cf. P. parvus*. Occlusal views in stereo. Left M^2 (SAM P24097), right M_2 (P31396), left M_3 (P31397), right M_5 (P31399, also in medial profile). Scale in mm.

(M^2) from Cement Mills, Gore, Queensland, reported by Bartholomai (1977) as *Palorchestes cf. P. parvus*.

Although the Gouldens Hole specimens differ from *P. parvus, sensu stricto*, there is not yet sufficient evidence to warrant erecting new species for them. Accordingly, they are referred, only tentatively, to *Palorchestes* sp. *cf. P. parvus*.

Geological Age

As noted above, the teeth are from a reworked mixed assemblage. The age can only be estimated at Pleistocene on the basis of other species of known Pleistocene age and similar preservation.

Curramulka Specimens

Corra-Lynn Cave (5Y1 in the National Cave register) contains a relict deposit of cemented fossiliferous silt (Pledge in prep.) which has yielded a large number of vertebrate species suggestive of a Late Tertiary age. Amongst them is a considerable number of isolated teeth (and some recognisable bones) of *Palorchestes* (Fig. 6). Measurements (Table 5) and morphological features suggest these best fit *Palorchestes painei* Woodburne, 1967 from the putative Late Miocene Alcoota Fauna of the Waite Formation (Woodburne 1967).

Material

This comprises: posterior half LM^3 (SAM P29860), LM^3 (P31331), RM^4(P29938), LM^5 (P26536, P29859), LI_1 (P29941), LM_2 (P29905), LM_3 (P29940), LM_4 (P29999), RM_5 (P30000). (Positional designation is based on relative size, shape and some morphological features of the 'links'.) There are also three very large, very compressed ungual phalanges of the form that has been ascribed to *Palorchestes* (Flannery & Archer 1985). These differ in detail from the damaged claw bones of phalange I of *Thylacoleo carnifex*, that have lost the protective 'hood'.

Description

Unworn molars show that these teeth are relatively high-crowned, more so than indicated for *P. painei* by Woodburne (1967, table 23) who suggests that *P. parvus* has higher crowned molars, but less so than the Gouldens Hole teeth. Turnbull & Lundelius (1970) calculated relative crown heights (*i.e.* the ratio of protolophid height to tooth length) for the Alcoota *P. painei* and their Hamilton specimen, as well as for two good *P. azael* specimens ($M_{3, 4}$) from Wellington Caves, obtaining about 0.52, 0.65, and 0.74 and 0.73 respectively. The values for specimens described herein are given in Tables 3–5. It is apparent that there are

TABLE 4. Cheek tooth dimensions (in mm), *Palorchestes* sp. *cf. P. parvus* from Gouldens Hole Cave, compared with *P. parvus* from Woods (1958) and SAM specimens.

Tooth	Specimen no.	Length (l)	width	protoloph (id) height (h)	h/l
P. sp. *cf. P. parvus*, Gouldens Hole					
M^2 (L)	SAM P24097	18.9	13.9	–	–
(R)	"	18.7	14.0	–	–
M_2 (R)	31396	17.7	10.0	10 ++	>0.56
M_3 (L)	31397	18.0	9.5	11 ++	>0.61
M_4 (R)	31398	–	12.2	(13+)	–
M_5 (R)	31399	21.2	12.6	15.0	0.71
P. parvus, Chinchilla					
M_2 (L)	QM F783 (type)	19.7	12.3		
M_3 (L)	"	20.6	12.6		
M_4 (L)	"	20.8	12.8		
M_5 (L)	"	20.6	13.1		
M_3 (L)	SAM P18432	18.4	12.5	10++	>>0.54
M_4 (L)	"	19.2	12.6	10++	>>0.52
M_5 (L)	SAM P18400	20.0	13.5	11+	>0.55

specific differences for this ratio, at least in lower molars, but there are also positional differences in teeth of the one species. It is suggested on this basis, at least, that the Hamilton and Curramulka specimens are conspecific, but that they differ from *P. painei, sensu stricto.*

Geological Age

Based on correlation of mammal and bird fossils, and the apparent absence of any rodent material, Pledge (in prep.) considers this deposit to be early Pliocene, or even Late Miocene, in age.

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TABLE 5. Tooth dimensions (in mm), *Palorchestes cf. P. painei* from Corra-Lynn Cave (Curramulka Local Fauna).

Tooth	Specimen no.	Length (l)	ant. width	post. width	protoloph (id) height (h)	h/l
M^3 (L)	SAM P29860	–	–	14.0		
M^3 (L)	31331	18.0	14.4	13.6		
M^4 (R)	29938	19 +	14.9	13.0	>9.0	
M^5 (L)	26536	19.2	13.4	11.6	>>8.5	
M^5 (L)	29859	20.7	14.9	12.3	11.6	0.56
I_1 (L)	29941	38.0	17.5			
M_2 (L)	29905	17.9	10.1	10.6	12 +	0.67
M_3 (L)	29940	18.1	10.5	10.6	>>9	>>0.50
M_4 (L)	29999	19.6	12.5	12.4	12.5	0.64
M_5 (R)	30000	17.8	12.4	11.0	11.0	0.62
M_3? (R) (*P. painei*, Alcoota)	P 31408	18.1	12.0	11.2	–	

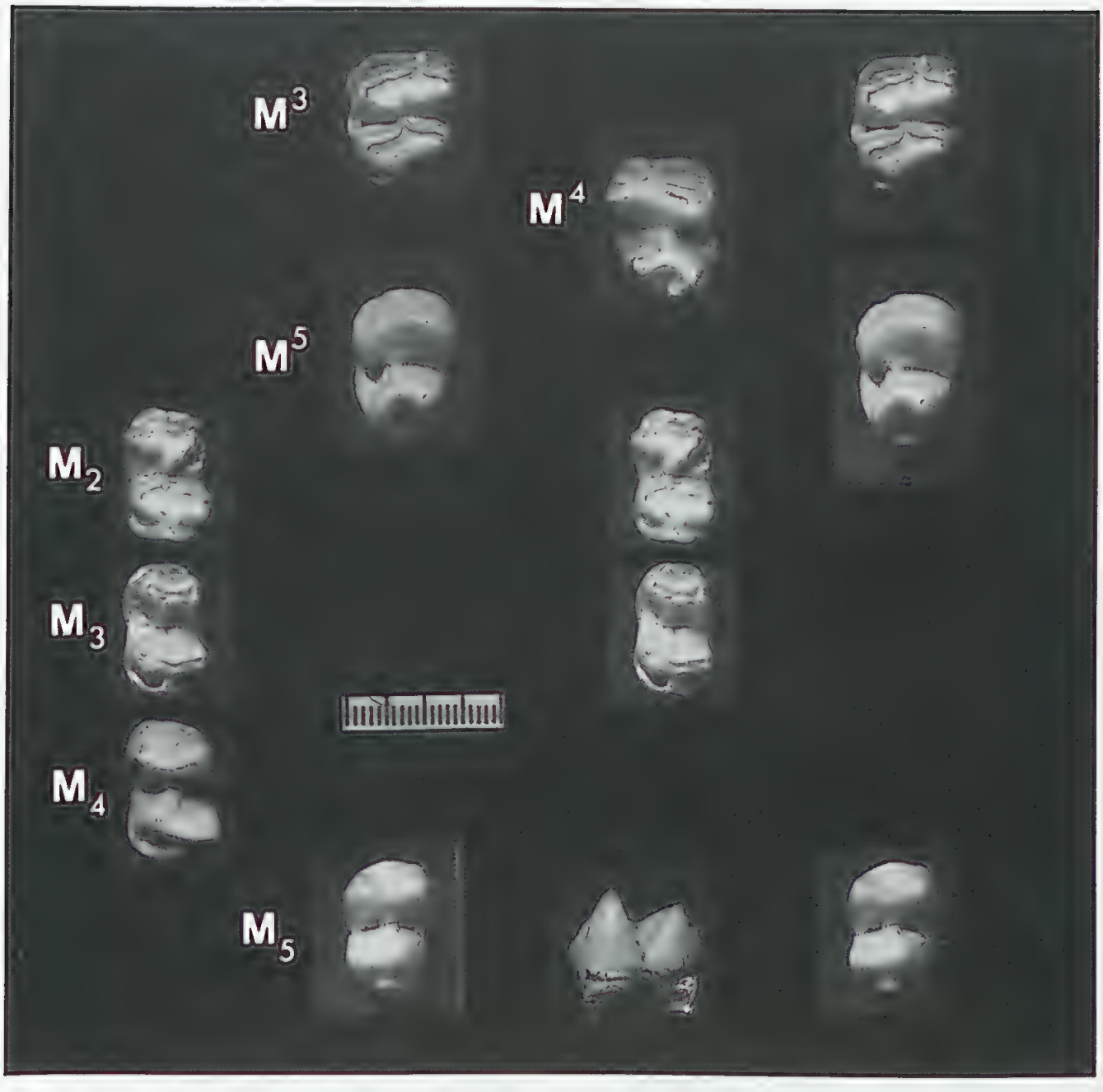

FIGURE 6. Corra Lynn Cave, Curramulka teeth, *Palorchestes* sp. *cf. P. painei*. Left M^3 (SAM P31331), right M^4 (P29938), left M^5 (P29859), M_2 (P29905), M_3 (P29940), M_4 (P29999), right M_5 (P30000, also in medial profile). (M^4 and M_4 not in stereo). Scale in mm.

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THE ARCHAEOLOGY OF THE JSN SITE: SOME IMPLICATIONS FOR THE DYNAMICS OF HUMAN OCCUPATION IN THE STRZELECKI DESERT DURING THE LATE PLEISTOCENE

M. A. SMITH, E. WILLIAMS & R. J. WASSON

SMITH, M. A., WILLIAMS, E. & WASSON, R. J. 1991. The archaeology of the JSN site: some implications for the dynamics of human occupation in the Strzelecki Desert during the late Pleistocene. *Rec. S. Aust. Mus.* 25(2): 175–192.

The earliest evidence of human occupation in the Strzelecki Desert is from the JSN site, discovered in 1979 during a geomorphic study of the dunefield. Further radiocarbon results confirm a late Pleistocene antiquity for occupation at JSN and indicate that the site was occupied on more than one occasion between 10 000–15 000 years ago. The location of the site suggests that this pattern of occupation reflects systematic use of the Strzelecki dunefield in the late Pleistocene. These findings refute the idea that there was no significant human occupation in the Strzelecki Desert-Cooper's Creek region, prior to the mid-late Holocene.

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The earliest evidence of human occupation in the Strzelecki Desert is from the JSN site (Fig. 1). The site was discovered by Wasson in 1979 during a geomorphic study of the dunefield (Wasson 1983) and takes its prosaic name from a nearby seismic line (79-JSN). A radiocarbon date of 13 850±190 yr BP (ANU-2278) for a small hearth became available as a result of this fieldwork. We can now report further radiocarbon results that confirm a late Pleistocene antiquity for occupation at JSN and which also indicates use of the site during the late Holocene. A full list of radiocarbon dates is given in Table 1.

The initial discovery raised a perennial but difficult question of interpretation. Although it showed the presence of humans in the core of the Strzelecki dunefield soon after the pronounced aridity of the last glacial maximum had passed, there was insufficient evidence to determine whether this was part of a regional pattern of occupation of the dunefield in the late Pleistocene or simply a fleeting visit. Despite considerable archaeological research in the decade since the discovery of the JSN site, other evidence of late Pleistocene occupation in the Strzelecki Desert-Cooper's Creek region has only recently come to light with the discovery of two hearths dating to about 12 000 yr BP adjacent to Cooper's Creek (Veth *et al.* 1990). Until these later finds were made the balance of archaeological evidence appeared to indicate that the region was not otherwise occupied until about 3–5 000 yr BP (Pretty 1968; Hughes & Lampert 1980; Lampert & Hughes 1987, 1988; Williams 1988). This lent support to the view that Wasson's hearth represented a single episode of occupation rather than a wider regional trend (*cf.* Lampert & Hughes 1987; Veth 1989: 87–88).

One might well expect to find some evidence of an expansion of human settlement into the Strzelecki Desert, coinciding with the progressive relaxation of arid conditions after the last glacial maximum (Singh & Luly 1991; Bowler & Wasson 1984). Initial reports

TABLE 1. Radiocarbon dates for the JSN site. All dated material was wood charcoal.

Sample code	Conventional radiocarbon age (years BP)	Context
ANU-2278	13 850±190	Wasson's hearth
ANU-2279	13 150±830	From aeolian unit below Wasson's hearth
ANU-7196	14 400±200	JSN/W3 earth oven
ANU-7197	10 500±230	Dispersed remnants of earlier oven beneath WJSN/N2
ANU-7198	2 400±270	WJSN/N2 earth oven

FIGURE 1. The Strzelecki Desert-Cooper's Creek region showing the location of the JSN site and places mentioned in the text.

of the age of Wasson's hearth put this at about 13 000 yr BP (Hughes & Lampert 1980), suggesting a close correlation with the end of the glacial-age climate. Moreover, the hearth was stratified above the last major aeolian unit in this part of the dunefield. The JSN evidence also seemed to fit in well with a small body of data from other parts of the arid zone suggesting that many parts of the interior, away from the comparatively well-watered montane and piedmont habitats, were reoccupied by about 10–13 000 years ago (*cf.* Smith 1988: 310–315).

In this paper we review the regional significance of the JSN site, drawing on unpublished details of the original work by Wasson in 1979, together with the results of further field investigations carried out in 1989 by Williams and Smith. Previous summary reports of JSN can be found in Wasson (1983: 102–103, 1984: 7 and fig. 6) and Hughes & Lampert (1980). Evidence now indicates that JSN was occupied on more than one occasion between 10–15 000 yr BP. We argue that this shows systematic human use of the Strzelecki dunefield during the late Pleistocene, given that JSN is not situated on obvious routes for travel within the region.

Further Investigations at JSN

Ten years ago Hughes & Lampert (1980) outlined a program for archaeological research in the Strzelecki Desert-Cooper's Creek region in which they pointed out the need for further work at JSN. In fact, the radiocarbon date for Wasson's hearth became available shortly before they began their fieldwork in October 1979 and they made an attempt to reach the JSN site. This was unsuccessful, apparently because of impassable drift sand.

In October 1989 Williams and Smith were able to relocate the JSN site using Wasson's original fieldnotes, sketch plans, and photographs together with directions keyed to the grid of shotlines established by SANTOS in the area. The objective was to clarify the nature of late Pleistocene occupation at JSN by determining whether there were other archaeological remains present and whether the setting of the site could provide any clues about its likely use. On this visit we could find no trace of the small hearth sectioned by Wasson ten years earlier. It could well have been either entirely removed by further erosion or buried by recent drift sand. However, the surrounding area was found to contain a number of other hearths and ovens and an extensive surface scatter of chipped stone artefacts, grindstones and baked clay heat-retainers scattered across several interdunal pans. Small excavations were undertaken to examine the internal structure of eleven features (Table 2), and surface collections of chipped stone artefacts and baked clay were also made in five sampling areas (Fig. 2).

TABLE 2. Features excavated in 1989.

Field code	Identification
JSN/W1	tree root
JSN/W3	earth oven
JSN/W4	hearth
JSN/W5	remnant of fire associated with JSN/W3
JSN/NE1	tree root
JSN/NE2	hearth ?
JSN/NE3	tree root
WJSN/N1	earth oven
WJSN/N2	rake out from WJSN/N1
WJSN/N3	tree roots (2)

In what follows we use the names JSN pan, WJSN pan and Wasson's hearth to refer to various components of the JSN site.

The Regional Setting

With a mean annual rainfall of 125 mm or less, the northern part of the Strzelecki Desert is within the most arid part of the continent. The major part of this region is an extensive dunefield made up of north-south trending sandridges with a dominant vegetation of *Zygochloa paradoxa* (sandhill canegrass). This is circumscribed to the north, west and east by stony plains and silcrete-capped hills (Fig. 1). Within the dunefield there are numerous small claypans and playas in the interdunal areas. There is also a major contrast between pale dunes, rich in clay pellets, to the west of Strzelecki Creek and red quartzose dunes to the east of the creek (Wasson 1983). The pale dunes lie in a structural depression in the underlying bedrock and there is a complete absence of outcropping rock in the portion of the dunefield lying between Strzelecki and Cooper's Creek. The JSN site is situated in this part of the dunefield, 40 km west of Strzelecki Creek (Fig. 1).

The channels of Strzelecki and Cooper's Creek periodically feed floodwaters from the north-east into the Strzelecki Desert. Immediately upstream of Innamincka, where the channel of Cooper's Creek is confined by rocky hills, there are a number of deep permanent waterholes. Downstream from Innamincka, Cooper's Creek floods out into the dunefield forming a maze of floodplains, shallow lakes and ephemeral swamps intersecting with the linear sandridges of the dunefield. In contrast, Strzelecki Creek has a narrow floodplain and presently fills from Cooper's Creek only rarely, when floodwaters at Innamincka top a rock bar.

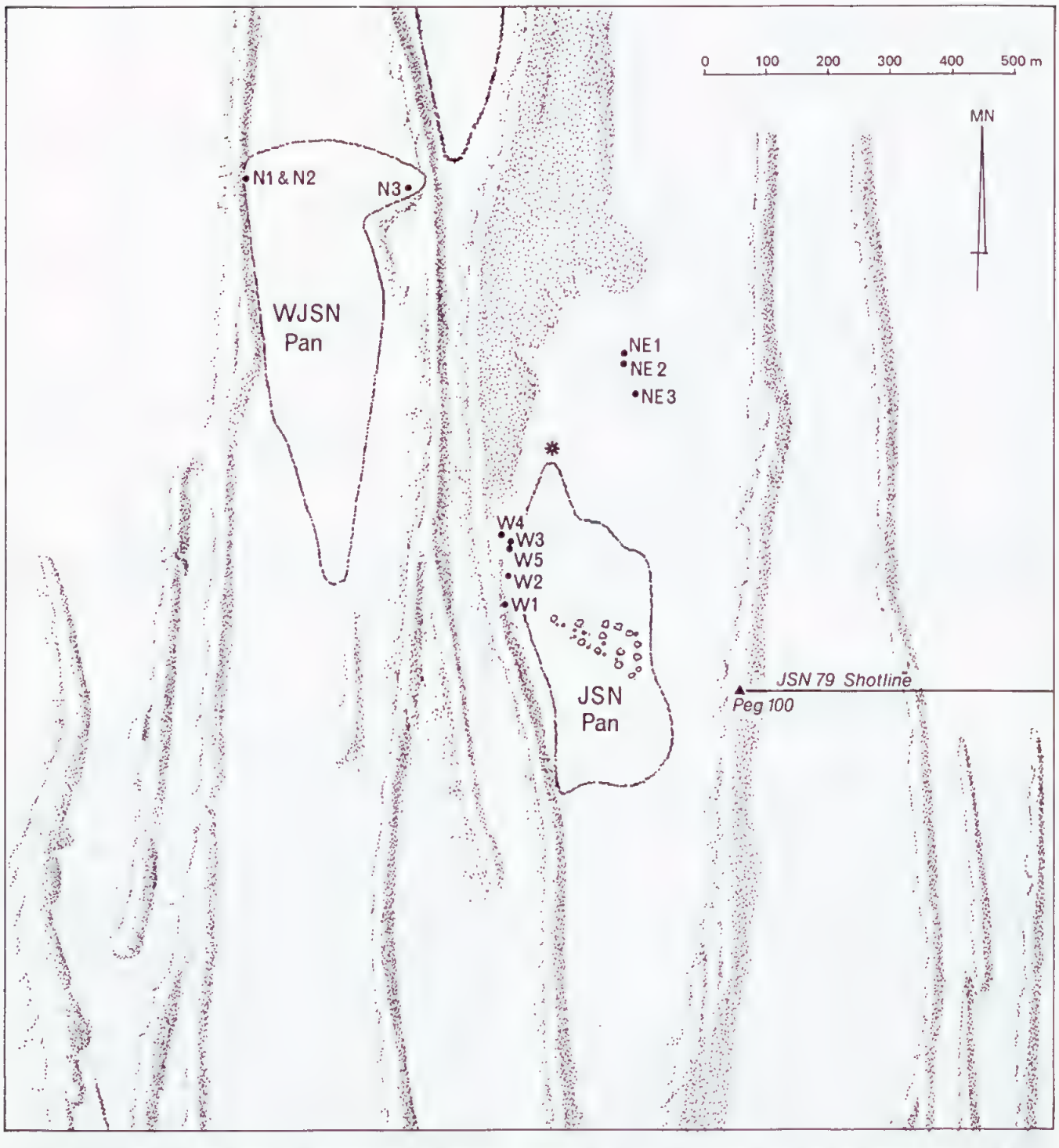

FIGURE 2. The JSN site showing the location of features excavated in 1989. Compiled from aerial photographs and 1989 survey plan. Star shows approximate position of Wasson's hearth.

Under most conditions Strzelecki Creek is a chain of semi-permanent waterholes, many of which are saline, linked by a poorly defined channel. It occupies a clear ecotone between the pale and red dune landscapes. On the floodplains the dominant perennial vegetation consists of *Eucalyptus microtheca* (coolibah) and *Atriplex nummularia* (old man saltbush).

The area around JSN is not presently reached by floodwaters from either the Cooper or Strzelecki Creeks. The configuration and stratigraphy of the dunes suggests that this was also the case in the late Pleistocene. The southern margin of the biologically productive Cooper floodout zone is 60–70 km to the north of JSN. The main channel of Strzelecki Creek, 40 km to the east, is the nearest watercourse but is a comparatively poor riverine habitat.

Description of the Site

Archaeological material at JSN is scattered over several interdunal pans (Fig. 2). There are many similar

pans throughout the dunefield and the JSN area is unexceptional.

The JSN pan is about 450 m long and 200 m wide, with a surface of grey/brown sandy cracking clay. It is closed off both to the north and south by low cross dunes to form a small basin, and it clearly collects local runoff. The dunes which surround it are of pale yellow pelletal-clay and are strongly rilled and sculpted by erosion. Within these dunes, Wasson (1984) identified three aeolian units; the modern mobile crests, a possible late Holocene unit and a Last Glacial unit (Fig. 3). Underlying the dunes and exposed on the flanks of the pan is a tough yellow/grey alluvium, containing authigenic groundwater gypsum, representing the substrate on which both the pan and the dunes rest.

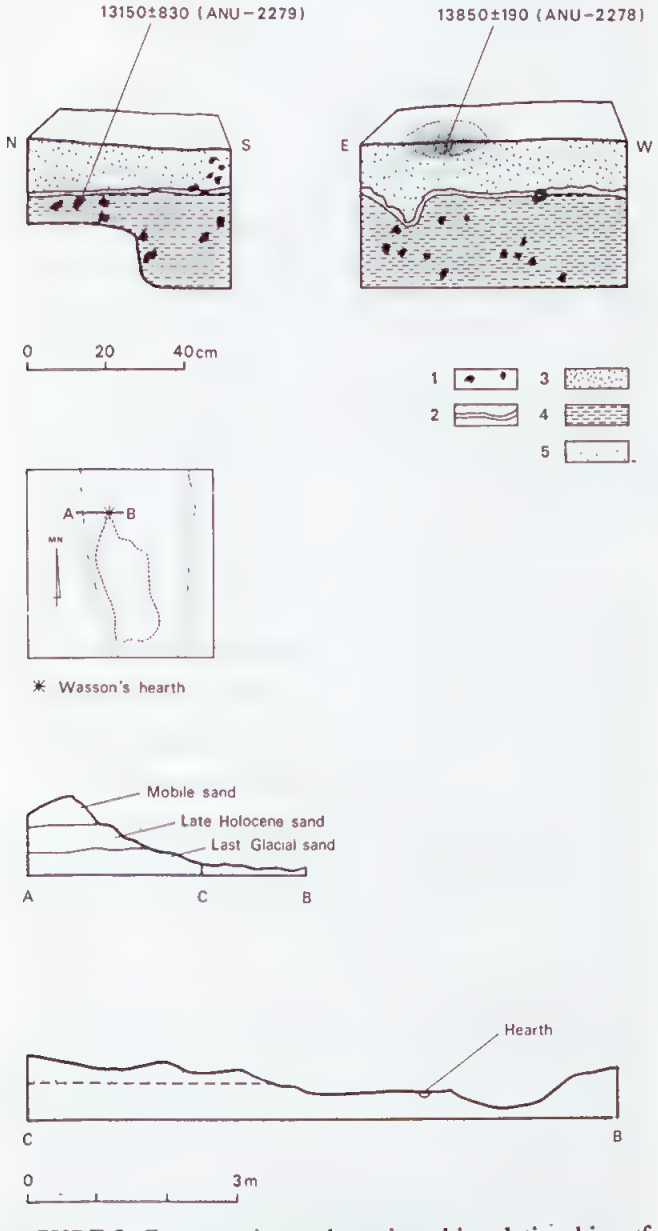

FIGURE 3. Cross-section and stratigraphic relationships of Wasson's hearth. (1) Large charcoal pieces. (2) Bleach developed in 3. (3) Yellow-grey fine sand, sub-horizontal laminae, fissile soft carbonate and clay pellets. (4) Very tough, pale yellow-grey fine sand, small hard and soft carbonate nodules and clay pellets. (5) Yellow-grey fine sand, low-angle laminae, no visible carbonate, no charcoal.

In 1989 the vegetation in the immediate area was sparse with some isolated stands of *Acacia ligulata*, *A. aneura* and other tall shrubs, such as *Hakea leucoptera*, *Eremophila longifolia* and several other species of *Acacia*. There was little ground cover apart from *Zygochloa paradoxa* on the dunes and a light cover of ephemeral plant species such as *Ptilotus* sp. on the surface of the pans.

To the west of the JSN pan there is another, larger, interdunal pan referred to here as WJSN. It is about 700 m long and 200 m wide and more sparsely vegetated than the JSN pan.

The visible archaeological remains consist of an extensive but low density scatter of chipped stone artefacts and baked clay on deflated areas at the northern ends of the JSN and WJSN pans (Table 3). In 1989 various features, either charcoal-stained sediment or concentrations of baked-clay lumps, were visible on the deflation surfaces. Eleven were excavated to test their identity (Table 2 and Fig. 2). The greatest concentration of baked clay lumps and stone artefacts occurs on the WJSN pan. Several pieces of *Velesunio* sp. shell were also recovered from this area and there is evidence of at least five individual hearths, as marked by discrete clusters of baked clay heat-retainers. On the JSN pan the density of archaeological material is lower but again there are indications of perhaps four to five hearths, in this case marked by dark charcoal staining with small pieces of burnt or baked clay.

Transects by Williams to the west and north of the JSN site and by Smith to the south and east confirmed that the site is a genuine concentration of archaeological material and not simply part of a background scatter of occupation debris. To the west and east of the site there is no appreciable background scatter of artefacts or baked clay. A light scatter of chipped stone artefacts and some grindstone fragments is evident up to one kilometre to the south of the site. Two other concentrations of archaeological material were observed. XKZ/E1 is a small hearth together with three stone artefacts and a piece of *Velesunio* sp. shell found adjacent to a floodout area five to eight km north of JSN. ESJN is a scatter of about 25 artefacts on a

TABLE 3. Distribution of archaeological material at JSN. Data excludes baked clay within discrete hearth concentrations.

sampling area	area m^2	baked clay no.	baked clay $g/10m^2$	chipped stone artefacts no.	chipped stone artefacts $no./10m^2$
JSN/W1	82	20	4	9	1
JSN/W3	277	115	8	21	1
JSN/NE	400	–	–	56	2
WJSN/N2	79	400+	159	55	7
WJSN/N3	630	76	11	266	4

claypan one kilometre due east of JSN. To the east the density of artefacts only rises again within a few kilometres of Strzelecki Creek, as shown independently by Wasson during a survey transect of the dunefield. The paucity of archaeological material in this part of the dunefield has also been noted by R. Callen (pers. comm.). Hughes (1983) commented on the low numbers of artefacts on sites in the dunefield west of Strzelecki Creek.

Hearths, Earth Ovens and Other Features

As few detailed descriptions of late Pleistocene hearths or ovens are available we present our observations in full below.

Wasson's hearth

The hearth excavated in 1979 (Fig. 3) was roughly circular in plan, about 20 cm in diameter, and plano-convex in cross-section. Its depth from the eroded ground surface to the base of the shallow basin was about 10 cm. Apart from charcoal and diffuse organic matter it also contained pieces of burnt clay and tiny lamellate fragments (1–2 mm) of shell, presumed to be *Velesunio* sp. shell by comparison with similar fragments of young shell from Strzelecki Creek. From its structure and contents it appears to have been a small cooking fire.

It was dug into a finely laminated yellow-grey sand that forms the calcareous B horizon of a palaeosol at the northern end of the JSN pan. Charcoal from the hearth gave a radiocarbon age of 13 850±190 yr BP (ANU-2278). Samples from the hearth were also examined for pollen by J. Luly but proved to contain only a few very eroded pollen grains.

In 1979 several other features were noted in this sector of the site. Some of these were simply ill-defined charcoal stains. At least two closely resembled Wasson's hearth before excavation, suggesting the presence of more than one hearth here.

The stratigraphic unit beneath the Bca horizon contained large pieces of charcoal and it is probable in this environment that such charcoal is evidence of human occupation. A radiocarbon date of 13 150±830 yr BP (ANU-2279) was obtained on large charcoal lumps from this stratigraphic unit beneath Wasson's hearth. The two radiocarbon dates overlap at one standard deviation and indicate a very rapid build-up of sandy sediment in this part of the site.

JSN/W2

This appeared as a diffuse charcoal stain about 40 cm in diameter with some small pieces of reddened baked clay embedded in the feature. As it was not sectioned it is not known whether it is simply a thin lens of hearth debris (see JSN/W5 below) or an intact hearth. Because of its distance from the other hearths described below it must represent a separate feature.

JSN/W3 and related features

This is a large earth oven, roughly sub-rectangular to oval in plan, 144 cm long and 70 cm wide (Fig. 4). It is well-defined, sub-rectangular in cross-section and at least 40 cm deep. It was dug as a steep-sided pit into the tough grey-brown clayey alluvium on the western flank of the JSN pan. As it cuts through a calcareous horizon, the fill of the oven contains small pellets of carbonate.

It contains large lumps of charcoal (up to 5 cm diameter) as well as large lumps of baked clay. The latter were presumably used as heat-retainers and range in colour from yellow (10 YR 8/3) or buff (7.5 YR 7/4), sometimes with a black core, to orange or red (10 R 6/8 or 2.5 YR 6/8). The former result from underfiring while a red or orange colour is characteristic of firing in a strongly oxidising atmosphere (Goffer 1980: 119–121; Joukowsky 1980: 367–369). As the most intense red colours are produced at temperatures of 700–900 °C, it seems likely that the original position of this material would have been at the surface of the fire where temperatures of greater than 600 °C are rapidly attained (*cf.* Clark & Barbetti 1982) and where a good draught could be expected. The present distribution of reddened baked clay lumps throughout the oven suggests major disturbance to their positions since the time of firing. Such disturbance would be expected during the normal use of an oven, particularly if the clay lumps were heated on an adjacent fire and then transferred to an oven pit (*cf.* Warner 1969: 131) rather than heated on a fire in the pit itself.

More significant is the re-use of the oven on at least one subsequent occasion. The evidence for this is a basin-shaped structure within the oven, at its western end, about 35–50 cm in diameter and defined by differential charcoal staining within the oven. Baked clay and large pieces of charcoal are concentrated in this part of the oven. As the structure fits neatly within the initial oven pit and does not cut across it, it can hardly be a fortuitous superimposition. A radiocarbon sample of charcoal from within this structure gave an age of 14 400±200 yr BP (ANU-7196). This dates the latest use of the oven, though one would not expect much of a time lag between initial use of the oven pit and its subsequent re-use.

The large size of the initial pit is unusual and warrants some comment here. In the arid zone there are no plant foods that require cooking in such a structure and it is larger than would normally be required to cook an emu (*Dromaius novaehollandiae*) or large macropod. The fact that there are only relatively small quantities of baked clay and charcoal in this pit is also surprising unless the initial oven was robbed of its contents to commission the later oven. Another possibility is that it was used to steam plant foods, perhaps leaves, stems or shoots, rather than to cook meat.

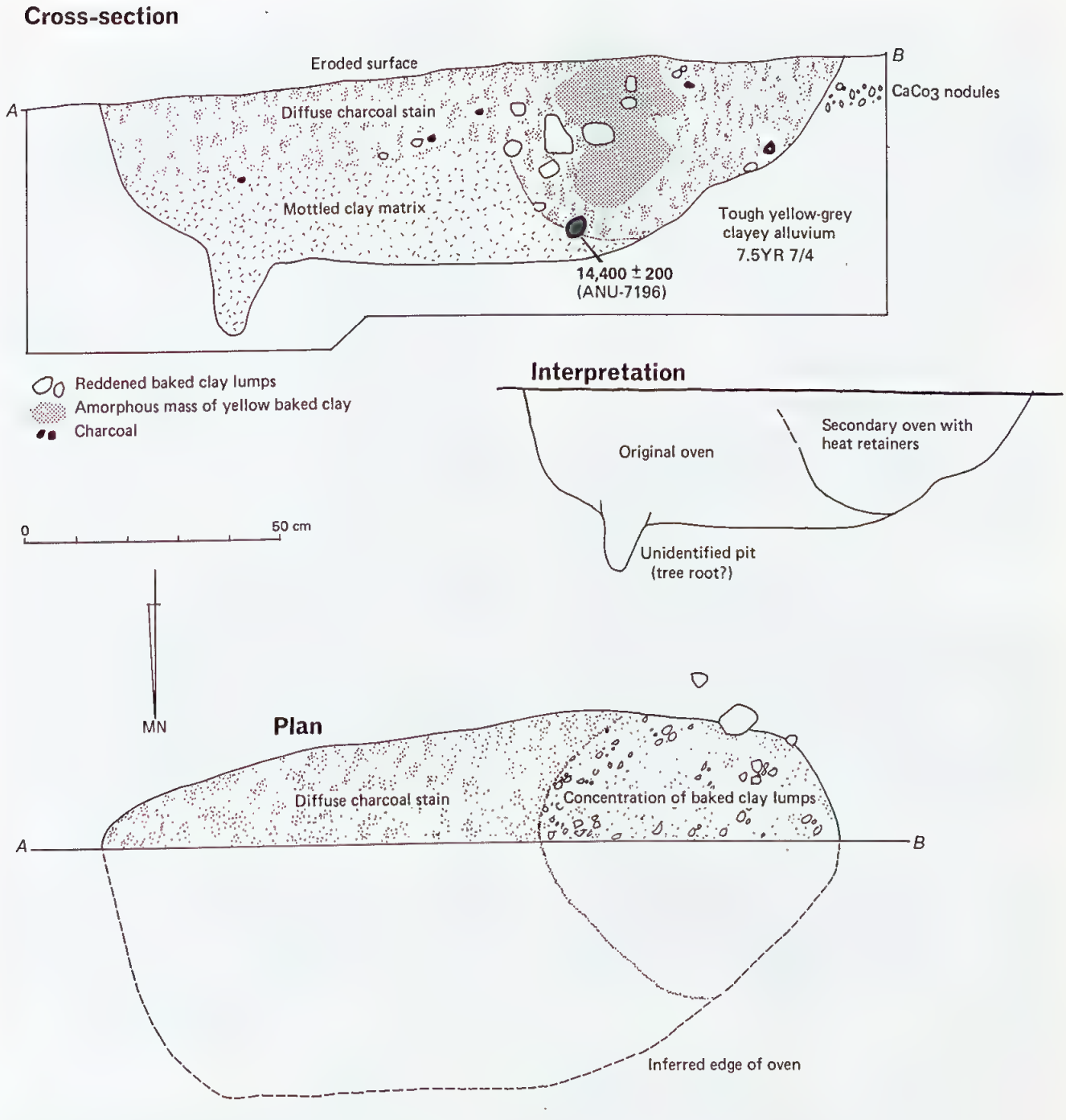

FIGURE 4. Plan and cross-section of JSN/W3 oven.

The dimensions of the secondary pit together with its roughly circular shape, concentration of baked clay lumps and large pieces of charcoal suggest subsequent use as an oven to cook an emu (*Dromaius novaehollandiae*).

JSN/W5 is a separate feature that may be associated with the JSN/W3 oven. This was visible on the surface as a large diffuse charcoal stain with some large pieces of charcoal (1–3 cm) and some small pieces of reddened baked clay embedded within it. Excavation exposed a series of large pieces of charcoal, dispersed in the sediment matrix rather than contained in a pit. Given that it is within two metres of JSN/W3 it may be a related feature, such as a dump of material removed from the oven. Another possibility is that it is the remnant of a fire to prepare the heat-retainers before they were placed in the oven pit. Clark & Barbetti (1982: 149) have drawn attention to the fact that such features are a likely archaeological correlate of the method of preparing earth ovens described by Warner (1969: 131) for north-eastern Arnhem Land.

JSN/W4

This appeared on the surface as a small circular concentration of burnt clay, about 30 cm in diameter, tightly clustered as a capping on a small residual. On

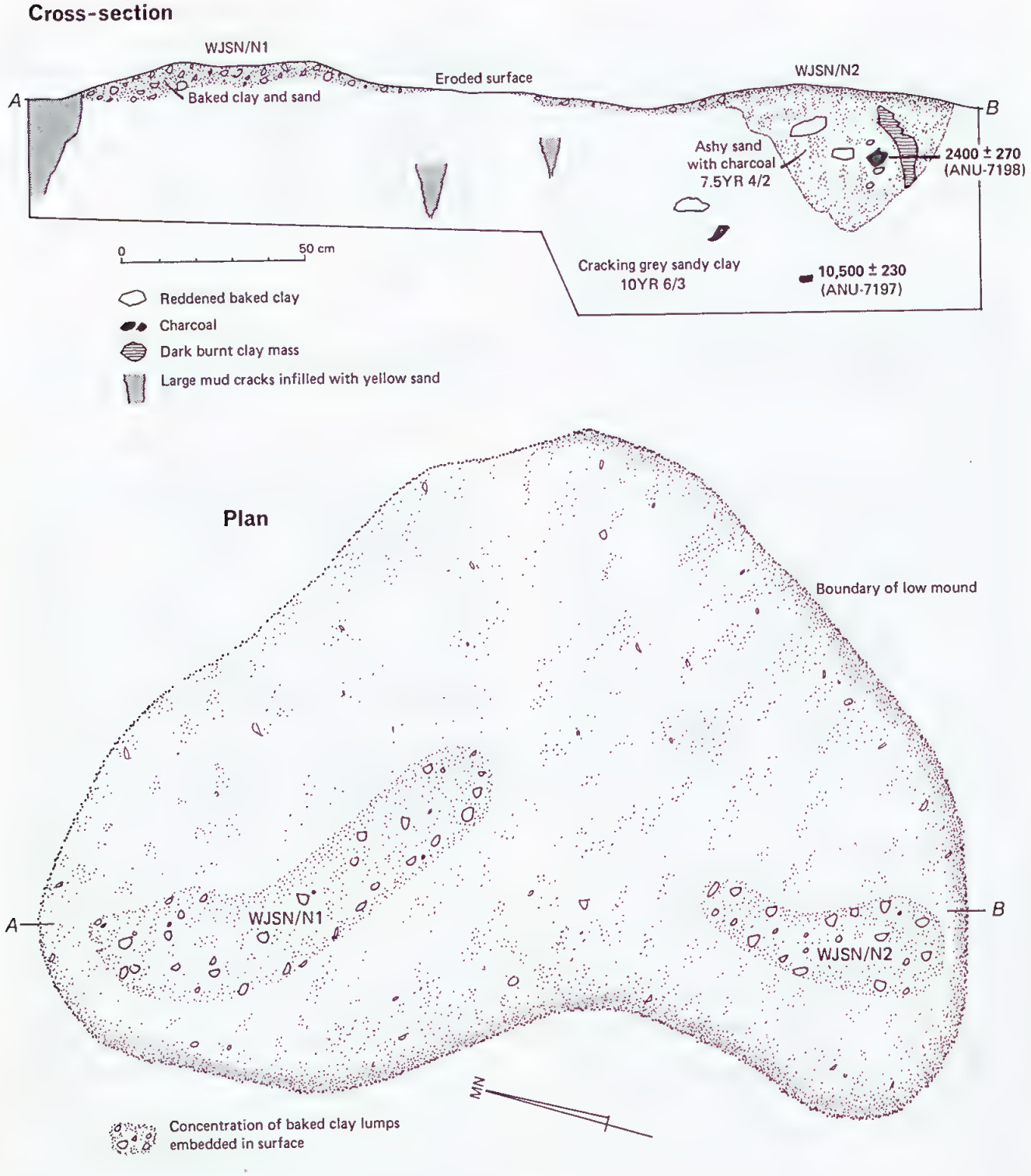

FIGURE 5. Plan and cross-section of WJSN/N2 oven.

either side of the residual a diffuse scatter of clay lumps extended outwards. None of the burnt clay was reddened. On excavation the hearth was revealed as a single layer of baked clay without any stratigraphic depth. This rests directly upon tough brown clayey alluvium. There was no visible charcoal or other occupation debris either within the feature or in the underlying sediment. This feature most resembles what have been described as 'hotplate' hearths (P. Clark, pers. comm.), in which a layer of heated flat rocks or burnt clay lumps is used to grill meat (*cf.* Kerwin & Breen 1981: 304).

JSN/NE2

This was a diffuse circular charcoal stain, about 45 cm in diameter, on a surface of laminated yellow-grey sand with flecks of calcium carbonate. In cross-section it is plano-convex, forming a very poorly defined shallow basin 16 cm deep. Its structure is similar to Wasson's hearth. However, as JSN/NE2 did not contain

any pieces of burnt or baked clay or fragments of shell we cannot be certain that it is of human origin, particularly given the prevalence of burnt tree roots in this sector of the site (see below).

WJSN/N1 & N2

WJSN/N1 is a dense concentration of baked clay capping a low rise. Excavation showed this to be a surface veneer, 2–5 cm thick, of baked clay and sand comprising rake-out from the WJSN/N2 oven (Fig. 5). The latter is a well-defined oven pit dug into the strongly pedal clayey alluvium that forms the substrate of the WJSN pan. The oven pit is roughly circular in plan, 55 cm in diameter, conical in cross-section and 40 cm deep. It is filled with a loose grey ashy sand, reddened baked clay, black burnt clay and large (1–3 cm) pieces of charcoal. A radiocarbon sample on charcoal provides an age for this feature of 2 400±270 yr BP (ANU-7198).

Several pieces of reddened baked clay and some very large lumps of charcoal (5–10 cm long) were observed within the underlying alluvium. Where this material is stratified beneath the oven it cannot be modern intrusive material. Nor was it associated with any of the large mud cracks in this unit. We believe that it most likely represents the dispersed remnants of earlier ovens. Subsequent radiocarbon results support this interpretation. Charcoal from beneath WJSN/N2 gave a radiocarbon age of 10 500±220 yr BP (ANU-7197).

Burnt tree-roots

Several other features were revealed upon excavation to be tree roots. In plan they were usually circular and much smaller than the hearths, about 10–15 cm in diameter. In cross-section they were diffuse charcoal stains, roughly cylindrical in shape, and often set in the ground at an angle. The number of such features in the JSN/NE area, including JSN/NE1 and NE3, suggests the presence of a stand of trees here at some time in the past. A similar observation can be made about the WJSN/N3 area where a series of diffuse, roughly cylindrical charcoal stains with carbonate root casts radiating laterally from them, testify to the former presence of a stand of trees. The remaining feature, JSN/W1, was unusual in that while it conforms to the morphology described above, it was only burnt for a few centimetres depth, where it was exposed at the ground surface. The remainder of the feature was a mould formed by decay of the root.

SEM identification of archaeological charcoals

A scanning electron microscope was used to examine the ultra-structure of archaeological charcoals in order to identify the species of wood used in the ovens. This aspect of our study was limited to the examination of charcoal retained from the three samples that were submitted for radiocarbon assay.

In this sector of the arid zone the range of species that is likely to be encountered in any assemblage of archaeological charcoals is comparatively restricted. Here, the archaeological charcoal was compared with reference samples of *Acacia ligulata* and *A. aneura* collected at JSN in 1989 and with reference material from other species not present around JSN today, such as *Eucalyptus* aff. *terminalis, E. microtheca, E. camaldulensis* and *Callitris glaucophylla.*

1) ANU-7197 (10 500±230 yr BP) is from an *Acacia*, possibly one of the clonal shrubs such as *A. ligulata* that grow at JSN today. The presence of biseriate rays serves to exclude *A. aneura.*
2) ANU-7198 (2 400±270 yr BP) proved to be too

TABLE 4. Composition of the JSN assemblage.

	JSN			WJSN		EJSN	OTHER	TOTAL
	W1	W3/W4	NE	N2	N3			
cores	–	–	1	–	6	2	3	12
redirecting flakes	–	–	–	–	2	–	–	2
backed blades	–	–	1	–	–	1	–	2
pirri points	–	1	–	–	–	1	–	2
other retouched artefacts	1	2	1	2	27	–	–	33
other chipped stone artefacts	8	18	53	53	231	–	–	363
total	9	21	56	55	266	4	3	414
hammerstones	–	–	1	–	–	–	–	1
seed-grinding implements	–	–	1	–	1	–	4	6
other grindstones	–	–	–	–	5	–	2	7

crumbly to withstand prolonged SEM examination but is probably also an *Acacia*.

3) ANU-7196 (14 400±200 yr BP) was indurated and so did not provide optimal conditions for identification. However, it is also clearly an *Acacia*. A second, independent sample of charcoal from the JSN/W3 oven is from a bloodwood, probably *Eucalyptus terminalis*, which occurs in parts of the dunefield today.

The results suggest that the late Pleistocene tree and shrub vegetation around JSN may have been similar to that of today, probably with some discrete stands of various species of *Acacia* as tall shrubs and with occasional sandplain *Eucalyptus* as isolated trees. The archaeological evidence clearly points to an environment where firewood was readily available between 10 000–14 500 years ago. It is also significant that none of the charcoal is from species such as *Eucalyptus microtheca* or *E. camaldulensis*, which occur along watercourses or on floodplains. The possibility of further reconstruction of the late Pleistocene vegetation using phytoliths is now being explored.

TABLE 5. Size of unretouched flakes in various sampling areas at JSN. Length is measured perpendicular to striking platform on axis through bulb of percussion. Data exclude broken flakes.

Sampling area	length (mm)			weight (g)		
	n	$\bar{x}$	SD	n	$\bar{x}$	SD
JSN/W1	3	14	6	3	1.5	0.7
JSN/W3 & W4	8	16	6	7	2.3	1.6
JSN/NE	23	13	6	23	1.5	2.2
WJSN/N2	17	16	6	15	1.9	1.6
WJSN/N3	82	19	10	78	5.1	9.7
Total	133	18	9	126	3.8	7.8

TABLE 6. Proportion of various categories of industrial debris in each sampling area at JSN. Data expressed as percentage of total number of artefacts in each area.

Sampling area	n	%			
		flakes	cores	retouched pieces	debitage
JSN/W1	9	33.3	–	11.1	55.6
JSN/W3 & W4	21	38.1	–	19.0	42.9
JSN/NE	56	41.1	1.8	3.6	53.6
WJSN/N2	55	30.9	–	3.6	65.5
WJSN/N3	266	38.0	2.3	10.9	48.9
Total	407	37.3	2.7	9.6	50.4

Chipped stone artefacts

The presence of distinctive implements such as backed blades, unifacial pirri points and seedgrinders (Table 4) immediately suggests a late Holocene age for much of the JSN assemblage. Tula adze slugs are notable by their absence though they are present on other sites in the Strzelecki Desert – Cooper's Creek region. All the artefacts were resting on deflated surfaces as 'float' rather than in primary stratigraphic context.

Given the range of radiocarbon dates for occupation at this site one would expect there to be a palimpsest of material of different ages on the deflation surfaces. However an impression that the bulk of the assemblage is late Holocene in age is reinforced by the absence of artefacts with a markedly greater degree of patination or with carbonate encrustation, despite the presence of carbonate nodules and root casts in some of the sample areas. The one artefact which does show a greater degree of weathering than the bulk of the assemblage, a large retouched flake (WJSN/N3-251), is made on a quartzite containing easily weathered mica, chlorite and other clay minerals.

To test whether there were any other differences across the site that might point to some temporal patterning within it, we compared the size of flakes from the various sample areas, the proportion of flakes, cores and retouched artefacts in the various collections and the types of raw materials used (Tables 5–7). The results show only minor differences across the site in flake size, assemblage composition, and in use of various raw materials. Therefore, we are unable to point to either any significant temporal patterning across the site or to evidence for a mixture of material of greatly differing ages within the assemblage. On balance, there seem to be few artefacts of late Pleistocene age in the assemblage.

The majority of the retouched artefacts consist of irregular pieces with short lengths of retouch along one or more margins. One specimen (WJSN/N3-116) warrants special comment. This is a small, chunky flake, 28 mm long with retouched margins converging to form a broad point. At the apex the edge of the implement exhibits crushing, pronounced rounding and a well developed polish. Starch grains (3–5 microns in diameter), cellulose and possibly some resinous plant material are present on the edge suggesting that the implement was used in scraping a soft, moderately starchy but not fibrous material. A firm identification is not available but a rootstock or tuber seems likely.

The roots of *Typha* or *Boerhavia diffusa* (tap vine) are possible candidates, bearing in mind that the implement may well have acquired its distinctive use-wear before being brought to the JSN site.

Sources of raw materials

JSN lies in a stone-free part of the dunefield and is some distance from potential sources of isotropic stone. The nearest of these are outcrops of silcrete along Strzelecki Creek at Chidlee Well, Merty Merty and at Lake Murteree, the latter with evidence for Aboriginal quarrying of the outcrop during the late Holocene (Hughes & Lampert 1980: 63–64). These outcrops are too small to have been included on existing geological maps (see Preliminary Edition – Strzelecki Sheet G54–2 1970). It is unlikely that there are any outcrops west of Strzelecki Creek as the bedrock in this sector of the dunefield has been subject to downwarping and is over 100 m below the surface (Wasson 1983: 91). The possibility that there is a local source of stone from gravels in palaeochannels underlying the dunefield can be ruled out.

The dominant raw materials present in the JSN assemblage (Table 7) are grey-yellow cherty silcrete and pink or grey fine-grained granular silcrete. Other raw materials are present in small quantities. These include cherts of various colours but similar lithology, silicified dolomite (Namba formation dolomite beds), black silicified wood (Eyre formation), quartz, and quartzite derived from water-worn cobbles.

The likely source of the cherty silcrete, chert, dolomite and pink silcrete has been identified by R. Callen (SADME), on the basis of fine-scale geological mapping in the Strzelecki region, as the Tertiary age Namba formation between Della and Dullingari Satellite Gas Fields. This is about 115 km north-east of the JSN site amongst the red quartzose dunes east of Strzelecki Creek, adjacent to its upper reaches. The silicified wood is probably also available in the Della-Dullingari area.

Grey fine-grained granular silcrete is the nearest isotropic stone to the JSN site, as it outcrops 40–50 km to the east at Merty Merty and Lake Murteree. However, the specific source of the material used at JSN is uncertain as small outcrops are widely distributed in the dunefield to the east of Strzelecki Creek. It also outcrops in the Della-Dullingari area.

We consider that outcrops in the Della-Dullingari area are the most likely source of the grey silcrete used at JSN. If the grey silcrete had been drawn from the closest outcrops to the site, one would expect it to be the most common raw material in the JSN assemblage. However, in this case it makes up only 31% of the assemblage whereas cherty silcrete and chert, both derived from sources in the Della-Dullingari area, together make up 59% (Table 7). If it had been obtained from sources significantly closer to the site than the Della-Dullingari area, we would also expect artefacts of grey silcrete to be less reduced than those made on cherty silcrete. In fact, there is no significant difference between the two raw materials in the size-distribution of artefacts (Table 8).

The likely sources of the quartz and quartzite cobble material are Flinders Ranges fan deposits near Moolawatana, south of Lake Blanche. At JSN, quartzite cobbles appear to have been broken during use as hammerstones or anvils rather than used as cores. Much of this material consists of irregular shatter fragments. There are few flakes and no retouched artefacts or cores of this raw material. This is also generally true of other varieties of course granular material (listed as 'other' in Table 7).

Selected aspects of reduction and curation at JSN

The composition of the assemblage (Tables 4 and 6) shows that not only finished flakes and retouched implements were brought to JSN. The high proportion of debitage and the presence of worked-out cores (Table 9) shows that knapping took place at the site. This is supported by the variability in the size of flakes and

TABLE 7. Raw materials in the JSN assemblage. Data expressed as percentage of total number of artefacts in each sampling area.

	cherty silcrete	chert	quartzite cobble	silcrete	quartz	silicified dolomite	other[1]
JSN/W1	22.2	11.1	11.1	33.3	–	–	22.2
JSN/W3 & W4	47.6	4.8	–	38.1	–	4.8	4.8
JSN/NE	32.1	14.3	–	39.3	–	–	14.3
WJSN/N2	67.3	5.5	1.8	21.8	1.8	–	–
WJSN/N3	42.1	18.4	2.3	29.7	0.4	–	7.1
Total	44.0	15.2	2.2	30.5	0.5	0.3	7.4

[1] miscellaneous coarse granular materials

TABLE 8. Weight (g) of artefacts on different types of silcrete. Data are (A) cores, (B) unretouched complete flakes, (C) debitage.

Material	n	$\bar{x}$	SD	Range
A.				
cherty silcrete	9	87.9	61.8	11.1–178.0
granular silcrete	1	64.0	–	–
B.				
cherty silcrete	34	3.1	3.2	0.3–16.3
granular silcrete	43	4.7	10.6	0.1–41.6
t 0.01 (1), 75 = 0.849				
C.				
cherty silcrete	74	5.6	13.0	0.1–98.7
granular silcrete	46	3.5	6.4	0.1–38.2
t 0.01 (1), 118 = 1.020				

debitage at the site, with both categories containing many items weighing less than a gram (Table 10). The latter are presumably the fine debris produced by stone-working.

With a core: flake ratio of 1: 22 there is no evidence to suggest that cores have been selectively removed from the assemblage. Although the proportion of flakes is a little lower than one would have expected, this might simply indicate that much of the reduction of particular cores took place before they were brought to the site. The low level of curation of the cores is further emphasised by the observation that at least half of the cores have been discarded while still suitable for removal of further flakes (Table 9). Nor is there evidence to indicate that large flakes or large items in the debitage category have been either selectively removed from the site or recycled as cores. For example, there is no significant difference between the size distributions of flakes and debitage (Table 10).

In Table 9 the cores collected from JSN are ranked roughly according to their state of reduction. They range from well-established but still viable cores to those that are at the end of their use-life. The latter are characterised by platform/core face angles of about 90°, the presence of major step-fractures that undercut the platform, a shape approaching that of a cube or sphere, and the presence of multiple striking platforms indicating rotation of the core to extend its use-life.

TABLE 10. Weight (g) of flakes and flaking debitage from WJSN/N3 surface collection.

Category	n	$\bar{x}$	SD	Range
unretouched complete flakes	79	5.1	9.6	0.1–48.9
debitage	125	6.7	12.0	0.1–45.4
t 0.01 (1), 202 = 0.989				

TABLE 9. Extent of reduction of cores. Specimens are ranked from viable cores (top) to exhausted cores (bottom).

wt (g)	shape[1] index	platform[2] angle	no. platforms	scar[3] ratio	no.[4] step fractures	cortex[5] present
64.0	6.8	55°	1	1.00	1	+
100.8	7.7	60°	1	1.00	1	+
52.7	8.1	65°	1	0.72	1	+
90.3	9.0	65°	2	0.89	0	–
30.8	10.9	75°	1	0.51	1	+
58.1	8.6	75°	1	0.55	1	+
178.0	9.0	70°	2	0.58	3	+
11.1	8.3	85°	1	0.92	2	–
173.3	9.0	85°	1	0.78	1	+
157.4	6.7	90°	1	0.59	5	+
123.4	7.3	90°	2	0.72	3	+
30.3	10.1	90°	5	?	2	–

1. Shape index is calculated as core height/$\sqrt[3]{\text{weight}}$. Values between 7–9 indicate a shape approaching a sphere.
2. Platform angle is average value to nearest 5°, measured on most viable platform.
3. Scar ratio is calculated as length of latest flake scar/core-face length. Values less than 0.5 indicate inefficient flake removal.
4. Number of major step-fracture scars.
5. + indicates more than 10% cortex.

In this assemblage several of the exhausted cores weigh more than 100 g yet there is no evidence of attempts to further reduce them by splitting the old core to create a fresh platform or by using bipolar percussion.

Inferences about site logistics in the mid-late Holocene

Studies by Byrne (1980) and Hiscock (1987) have elegantly demonstrated a general correspondence between the morphology of artefacts on a site and distance from source of the stone. This is based on the premise that with increasing distance from a source it is increasingly unlikely that the supply of stone can be replenished, while the existing stock-in-hand, sometimes called the curate set or donor assemblage, is continually being diminished. People using the dunefields in the Strzelecki Desert would presumably have carried a small stock of cores and implements with them, probably no more than 2–3 kg per family. As they moved along a chain of campsites this stock would be progressively depleted as new flakes were produced for various tasks and as existing implements were resharpened. At each site in the chain various items would be discarded, usually exhausted cores, worn out implements and the debitage from knapping. As the stock of stone diminished, one would expect criteria governing the discard of items to be tightened and attempts made to recycle, rejuvenate or ration (Hiscock 1987) the material at hand. The lack of stone in this part of the Strzelecki dunefield precludes substitution by local raw materials.

Given that the JSN site is in a stone-free sector of the dunefield and is at least 40 km from the nearest potential sources of isotropic stone and over 100 km from the sources apparently utilised, one could expect that the stone artefacts discarded at the site would show the hallmarks of extreme reduction. This is not the case and allows us to make some inferences about the scheduling and logistics of late Holocene occupation at JSN.

Comparison with sites at Coongie Lakes

The unusual character of the JSN assemblage is brought out by comparison with assemblages from other sites in the region. Archaeological sites adjacent to the Coongie Lakes, in the northern part of the Cooper floodout zone, are a comparable distance from potential sources of stone. Some of these sites are very extensive and have a comparatively high density of artefacts (Williams 1988), consistent with ethnographic accounts of large groups of people living in semi-sedentary conditions while the lakes held water. The assemblages on these sites contain few intact cores and most of these are very small (Tables 11 and 12), close to the theoretical limit at which Hiscock suggests bipolar techniques become necessary for further reduction (Hiscock 1982: 39–41). Exhausted cores appear to have been recycled as implements. Artefacts in these assemblages are also very small, with mean weights of about 3–4 g.

In contrast, artefacts and cores at JSN are much larger (Tabels 11 and 12) and cores are better represented in the assemblage. There is no evidence that cores have been recycled as implements. Many have been discarded while still viable (Table 9). Some are as large as cores at the quarry in Byrne's study (1980). Although there is no primary decortication phase represented in the JSN assemblage, nearly 20% of flakes and 75% of the cores still retain some cortex. Thus the JSN assemblage shows neither the direct effects of distance from stone sources, nor the mediating responses that one would expect to have operated to offset a diminishing stock of stone.

Interpretation

The studies by Byrne (1980) and Hiscock (1987) quoted above both use linear distance from source as an approximation of gross time since procurement. However, in the case of JSN the condition of the chipped stone material is not consistent with the distance from source irrespective of whether the actual source of much of the JSN raw material is 40 or 115 km away. This indicates that people must have travelled fairly directly from the source to the site, without spending a great deal of time foraging and camping in transit. The dumping of useful items at JSN, especially viable cores, also indicates that people must have expected to be able to replenish their stock of stone elsewhere within a day or two of leaving the site.

TABLE 11. Comparison of JSN and various Coongie Lakes sites (Williams, unpubl. data).

	no. artefacts per sq. m	mean wt artefacts g	% flakes	% retouched artefacts	% cores
JSN site	0.3	6.6	37.3	9.6	2.7
Marroocoolcanie	7.9	2.6	59.9	8.3	0.8
Toontoowaranie	7.0	2.6	63.9	7.3	–
Lake Lady Blanche	2.1	4.4	59.1	24.1	1.0

TABLE 12. Weight (g) of cores at JSN and various Coongie Lakes sites (Williams, unpubl. data).

Site	n	$\bar{x}$	SD
JSN	12	89.2	57.9
Marroocoolcanie	4	7.7	7.6
Lake Lady Blanche	2	13.7	2.6

JSN/M: t 0.05 (1), 14 = 2.744
JSN/LLB: t 0.05 (1), 12 = 1.783

Therefore, it seems likely that people intended to travel directly back to Strzelecki Creek after leaving the site. In this regard the chipped stone artefacts identify the JSN locality as a specific destination that people travelled some distance to reach, not one occupied during the course of itinerant use of the dunefield and floodplains. These ideas could be tested by further fieldwork as we would expect artefacts on other sites in the surrounding dunefield to show a degree of reduction more consistent with their distance from sources of isotropic stone. Some indication that this is indeed the case is given by Hughes (1983: 9–10).

The duration of visits to the JSN site must also have been relatively short, so that the demand for stone was easily met by the stock-in-hand without recourse to the recycling and extreme reduction of stone evident at the Coongie Lakes sites.

The fact that much of the isotropic stone at JSN is from sources in the Della-Dullingari area supports a suggestion by Hughes (1983: 11) that the predominant pattern of movement of people into this sector of the dunefield was west along the Cooper floodout zone and then south along the interdunal corridors rather than east-west across the grain of the dunefield from Strzelecki Creek. If people had simply travelled down Strzelecki Creek and then directly out to JSN it is unlikely that so much cherty silcrete and chert from the Della-Dullingari area would have been transported to the site. Fresh supplies of stone could have been acquired much closer to JSN at Lake Murteree, or at other outcrops of silcrete along Strzelecki Creek.

Grindstones

Small numbers of seed-grinding implements and other grindstones are present at the JSN site. There are 13 grindstones in the surface collection, most of which are probably fragments of larger seed-grinding implements (Table 13). Six retain enough diagnostic features to allow positive identification as fragments of either millstones or mullers (*cf.* Smith 1986). As none of the grindstones is heavily patinated or carbonate encrusted, there is nothing to suggest that they pre-date mid-late Holocene occupation of the site.

A variety of lithologies is represented, including pink, grey, brown and white varieties of sandstone. These range in texture from very fine-grained through to gritty sandstone. Some appear to be from tabular sources, others from boulder or cobble sources. Three specimens are on quartzite or metasediment cobbles. This variability is characteristic of sites in stone-free parts of the Strzelecki Desert-Cooper's Creek region where stone for grindstones was one of the commodities in the regional exchange system (McBryde 1987). One of the major conduits for the movement of exotic materials was Strzelecki Creek and it is likely that here grindstones from a variety of sources would be in use at any one time. In this respect one would expect the lithology of the grindstones at the JSN site to be more informative about exchange systems at the regional level than about local patterns of land-use and resource procurement. However, to the extent that we have been able to identify sources, the grindstones suggest a broadly similar pattern of movement of raw materials to that shown by the chipped stone artefacts.

The JSN grindstones were examined by A. Watchman. On hand examination none match material from known grindstone quarries at Anna Creek or Tooths Nob. Two specimens, including one which is a rim fragment of a millstone, are of white, coarse-grained, poorly sorted sandstone similar to that reported from the Narcoonowie quarry (Hughes 1983) 67 km south-east of Moomba. Two other specimens, on medium-grained brown sandstone, resemble material available from quarries in the Innamincka area. Both of the latter specimens are near-complete mullers.

The size of the grindstone fragments at JSN is variable (mean weight 148 g) but the largest example weighs 482 g. One specimen has seen subsequent use as an impromptu core. The majority, although broken, do not show signs of obvious recycling, such as

TABLE 13. Typological classification of the JSN grindstones.

muller	3
millstone fragment	1
pestle	2
undiagnostic fragments	6
amorphous grindstone	1
Total	13

crushing, battering or flaking. This suggests that they were brought to the JSN site as grindstones rather than as convenient pieces of sandstone recycled as hammerstones or cores. If so, the presence of seed-grinding implements is intriguing, as JSN is well away from the floodplains which are the most productive habitat for panicum (*Panicum decompositum*) and ngardu (*Marsilea* spp.). It is possible that other types of seed, perhaps from various species of *Acacia* or *Portulaca*, might have been locally available.

Mussel Shell

In the surface collection from WJSN/N3 there are 30 small pieces of freshwater mussel shell with a total weight of 12.3 g. A single small piece (1.4 g) was found elsewhere on the site and another, weighing 7.7 g, was also found adjacent to the XKZ/E1 hearth, to the north of the JSN site.

None of these fragments retain sufficient features to allow positive identification to species, which in the case of freshwater mussels requires nearly complete shells. However, the most likely species is *Velesunio wilsonii* as this is the only large bivalve present in the Cooper basin today (McMichael & Hiscock 1958; Cotton 1961). The thickness of the archaeological material, 2–3.5 mm, rules out the smaller *Corbiculina* sp. bivalve.

The shell collected in 1989 is assumed to be of mid-late Holocene age because of its association with the dense scatter of chipped stone artefacts at WJSN/N3. However, Wasson's hearth also contained tiny (1–2 mm) lamellate fragments of shell, probably also *Velesunio* sp., which must be of late Pleistocene age. Freshwater mussels are unlikely to have ever been available locally at the JSN site and must have been brought in to the site from one of the deep waterholes along either Strzelecki Creek or Cooper's Creek. The small amount of shell involved indicates that the shellfish were probably brought in as implements rather than as food. Kerwin and Breen (1981: 308–9) record the use of mussel shells as spoons for ngardu in the Innamincka area. Although fragile the shell is obviously suitable for a range of other uses. For instance, Cotton (1961: 175–176) notes the use of *V. ambiguus* shell along the Lower Murray River for cutting up fish, skinning animals and working wood. Hercus & Clark (1986) also report the presence of freshwater mussel shell on archaeological sites in the centre of the Simpson Desert.

Discussion

Nature of Prehistoric Occupation at JSN

The JSN site was occupied on more than one occasion between about 15 000 and 10 000 yr BP. There seems a good chance that further excavation of features, as they are exposed by erosion, would add detail to this chronology. Occupation during this period left a series of ovens and hearths and some freshwater mussel shell at the site. The lack of any appreciable number of stone artefacts suggests that occupation at this time may well have been more transitory than later use of the site. But the rapid accumulation of sediment, evident at the northern end of the JSN pan (Fig. 3), together with the widespread occurrence of large pieces of charcoal in this unit also suggests that people and their fires may have had sufficient impact to locally destabilise dunes.

JSN was also a focus for occupation in the mid-late Holocene. The long history of use of this site is in marked contrast to the paucity of archaeological remains elsewhere in the western part of the Strzelecki dunefield. This shows that the JSN locality must have had qualities which repeatedly drew people to this point in the dunefield. Analysis of the stone artefacts reinforces this view. During the late Holocene, people appear to have travelled more-or-less directly out to JSN from the Cooper floodout zone some distance away, stayed for a short period and then travelled back towards the riverine corridor of Strzelecki Creek. This phase of occupation left ovens, hearths and mussel shell as well as chipped stone artefacts and seed-grinders.

It is not clear why the JSN locality was favoured for occupation. One possibility, given that large animals are otherwise known to have been quite rare in the Strzelecki Desert-Cooper's Creek region (Kemper 1990), is the availabilty of game. The presence of earth ovens confirms that either large macropods or emu were exploited in the area. We also observed several emus at the site in 1989. Another possibility is the opportunity to salvage raw materials, especially stone, from previous episodes of occupation of the site. However, the lack of evidence for the recycling of stone or the re-working of older artefacts seems to rule this out, as does the absence of artefacts that can be attributed to the first phase of occupation at the site.

Water must also have been a critical determinant in allowing access to this part of the dunefield, but there is nothing to suggest that JSN is better served than other interdunal pans in the region. The JSN pan collects run-off after local rain. *Conchostraca* shells were found on the surface in 1979, confirming the presence of standing freshwater at some time. However, this need not have been very substantial as these small crustaceans are only found in ephemeral pools and can flourish in a few centimetres of fresh water. In 1979, Wasson also noted that the eastern flanks of nearby dunes had been trimmed by waves, presumably after exceptionally heavy local rainfall in 1973–76, but this was also the case elsewhere in the dunefield. JSN is not strategically situated with respect to groundwater. Drilling by Delhi Australia, about 20 km to the north, showed hyper-saline water at approximately 80 m

depth. Nor is the site located near any of the palaeochannels that underlie the dunefield. At best, any soakage at JSN would most likely be derived from local infiltration into the dunes, similar to the *mikiri* wells of the Simpson Desert (Hercus & Clark 1986).

Local ethnohistoric accounts shed no light on why JSN was a focus of prehistoric occupation. For instance, although the 1904 H. J. Hillier map provides Diyari and Yandruwantha place names for several places in adjacent parts of the dunefield (*cf.* Reuther 1981), none is given for the JSN locality.

Whatever the attraction may have been, humans were visiting the JSN area by at least 14 400 yr BP. Repeated use of the site since that time is unlikely to have been due simply to chance, as the site is not situated in any obvious natural corridor for travel through the region. In fact, JSN is in an otherwise undistinguished part of the Strzelecki dunefield. The most likely interpretation is that it reflects regular use of the dunefield, probably with semi-permanent occupation of the riverine corridors already in place by the late Pleistocene. The presence of *Velesunio* shell at JSN, in both late Pleistocene and mid-late Holocene contexts, is tangible evidence of some link with these riverine habitats. Although speculative, we favour the idea that the JSN area was one where people could depend on finding large game, otherwise rare in the more intensively exploited riverine and floodplain habitats. If so, it is plausible that people would have taken advantage of local rainfall to travel specifically out to the JSN area to hunt these animals, and that such visits would have been short, given the ephemeral nature of local waters.

The pattern of use of the JSN site changed sometime during the mid-late Holocene. At this time visits appear to have become more prolonged though not necessarily more frequent, and to have involved the grinding of seeds and the manufacture and maintenance of chipped stone artefacts. In contrast, late Pleistocene use of the site probably did not involve much on-site stone working. At this time, people may have brought in finished flakes and implements but did not discard them in any appreciable number at JSN.

Regional Significance

Evidence for late Pleistocene occupation at JSN, together with recently reported radiocarbon dates of about 12 000 yr BP for two hearths on the lower reaches of Cooper's Creek (Veth *et al.* 1990), refutes the idea that there was no significant human occupation of the Strzelecki Desert – Cooper's Creek region prior to about 3–5 000 years ago. Riverine, dunefield and montane habitats in this sector of the arid zone were all occupied in some fashion between 10 000 and 15 000 BP.

With radiocarbon dates of 13 850±190 (ANU-2278) and 14 400±200 yr BP (ANU-7196), first evidence of occupation at JSN coincides with the end of the first phase of climatic amelioration in this region. This phase began about 16–17 000 yr BP, a time when the pollen and sedimentary records at Lake Frome (Singh & Luly 1991; Bowler *et al.* 1986) show that a major period of lake floor deflation, coinciding with the last glacial maximum, had ended. Lake sediments began to accumulate again and trees, mainly *Callitris* and *Eucalyptus*, recolonised the region. At this time, the climate was cooler than modern, with a winter-dominated rainfall. This phase ended abruptly at about 14 500 yr BP when the trend towards gradual climatic amelioration was reversed, rainfall again declined and Lake Frome became much shallower. These more rigorous conditions persisted until about 13 000 yr BP.

The new radiocarbon dates for JSN also show clearly that first use of the site took place before the re-establishment of summer monsoon incursions into this region at 13 000 yr BP (Singh & Luly 1991). The climatic and environmental changes at this time mark the end of the glacial-age climate and we might otherwise have argued that this was the most likely time for any expansion of settlement into regions such as the Strzelecki Desert. At this time, the pollen record at Lake Frome registers the onset of summer rainfall and higher temperatures. The lake filled with water sufficiently to build beaches several metres above the floor of the modern salina. Around 12 000 yr BP, Cooper's Creek also responded to a major hydrologic change as its catchment was revegetated and sandy sediments were no longer carried in quantity.

In this context it is unlikely that the earliest dates at JSN record the initial stages of re-colonisation of the Strzelecki Desert. There is no reason now why this should not have taken place closer to 16–17 000 yr BP. If further work shows this to be the case, it would also indicate that the major impact of glacial aridity, at least upon population distribution (*cf.* Lampert & Hughes 1987; Smith 1989; Veth 1989), was restricted to a comparatively narrow time-interval, perhaps already ended by 17 000 yr BP. It is also important to note that we cannot yet dismiss the alternative possibility that people continued to occupy the Strzelecki Desert-Cooper's Creek region throughout the peak aridity of the last glacial maximum. The deep permanent waterholes along Cooper's Creek, between Innamincka and Nappamerrie, may well have supported such a population.

Finally, although the riverine corridors were probably a key focus of occupation in the Strzelecki Desert – Cooper's Creek region during the late Pleistocene, the evidence from JSN also shows that people were able to exploit the resources of the dunefields at this time. Thus they would have been in a position to gain a working knowledge of the ecology of such habitats at an early date. This weakens an argument, recently put forward by Veth (1989), that major sandridge deserts, such as the Simpson Desert

to the north, would have constituted biogeographic barriers to human settlement until the mid Holocene.

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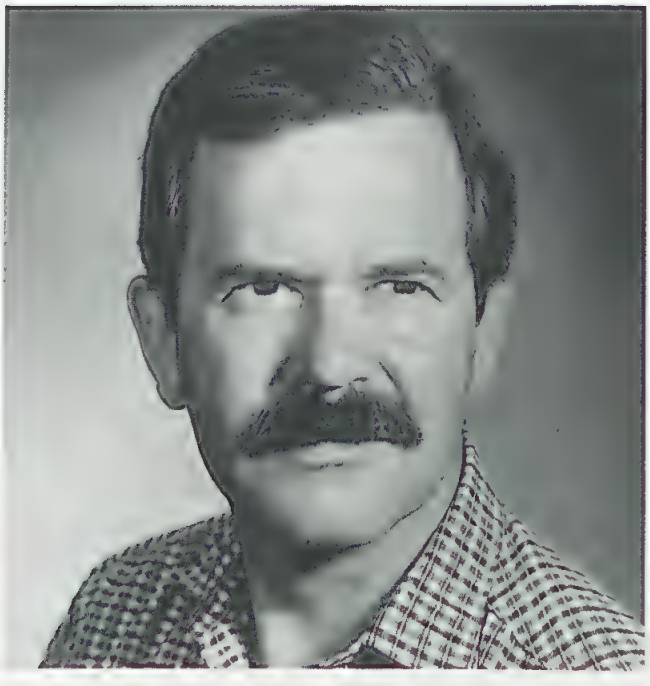
OBITUARY

WILLIAM GRANT INGLIS

9 August 1928 – 26 March 1991



Grant Inglis was born in Cupar, Fife, Scotland, the eldest of three children, the other two being sisters. At a very early age he moved with his family to Lockerbie where his father taught music at Lockerbie Academy. The three Inglis children were educated at that establishment until their early teens and their schooling was completed at Dumfries Academy. Grant did his National Service training after leaving school and before going to Aberdeen University where he planned to take a degree in forestry. However, he changed to zoology in his second year – a profession he followed for the rest of his life.

After graduation from university he joined the staff of the British Museum (Natural History), now the Natural History Museum, in 1953. There he headed the Aschelminth Section until 1968. In 1958, Grant Inglis was awarded his Ph.D. by the University of London; and in 1965 he was awarded his D.Sc. from his old university, Aberdeen. He rose to the rank of Principal Scientific Officer at the Natural History Museum and was Dean of Studies at the Working Men's College in London. Always a keen mountaineer, he participated in and led a British Museum (Natural History) expedition to Nepal in 1961–62.

In 1966–67, Grant Inglis came to Australia as an exchange worker at the Western Australian Museum and so began his long association with this country. Soon after his return to England from Australia, the position of Director of the South Australian Museum became vacant and he was appointed to that institution on 2 September 1968.

The Directorship of the Museum also carried with it the office of Protector of Relics, as provided for in the Aboriginal and Historic Relics Act, 1965. Memorials to Grant, albeit now made obsolete by recent legislation, may still be seen throughout the State in the form of brightly painted, white-on-blue notices proclaiming this or that object to be under his protection. Through this role and that of Museum Director, Grant Inglis travelled the length and breadth of South Australia where his wit and bonhomie won him many rural friends. In turn the harsh beauty of the Australian landscape enthralled him.

Upon his arrival at the Museum, Inglis laid down his policy of emphasis on South Australia in both research and display, aided by comparative work from other regions where necessary. He also perceived a need for more resources to be expended on public programs, particularly exhibitions, than curation and research, because he felt the latter had had a good run during the preceding few years. He also saw a need for the salaries of exhibitions staff, or preparators as they were known then, to be augmented significantly in line with the importance of their role in the Museum's overall functions.

Grant Inglis, along with his predecessors and successors, inherited immense problems of inadequate and unsuitable space for work and collections in a twentieth century museum. He tackled these with vigour, and several options came and went during his tenure. Finally, during 1971, approval was near for a northward extension from the Museum's west wing to accommodate collections and research areas. In time, however, that also was superseded by yet another plan.

By this time Inglis was heavily involved with a Committee of Inquiry on Environment in South Australia (the Jordon Committee) which led to the establishment of the Department of Environment and Conservation, of which he was to become the first Director on 28 February 1972. The South Australian Museum went with its former Director to the new Department of which it became a division.

In 1976, a new South Australian Museum Act was proclaimed, which increased the size of the Board from five to six, and Grant Inglis was appointed to the Board from 18 May 1976 to 16 March 1980. However, he was rather unceremoniously removed from the position of Director (Permanent Head) of Environment and Conservation in 1977 and transferred to the Education Department as Deputy Director-General, Museums and Botanic Garden Services; these organisations were also removed to the Education Department. This situation existed until September 1979 when a new government established the State's first Department for the Arts, to which the South Australian Museum was joined. Grant Inglis then was transferred to the Department of Fisheries as Senior Scientific Adviser and ceased to have any formal administrative links with the Museum after March 1980; but he did become a familiar figure about the Museum again as he directed his remarkable mind once more to systematic zoology.

Grant Inglis remained with the Department of Fisheries until April 1987 when he retired. Officially appointed as adviser to the Department, in fact he pursued his research in systematic zoology and produced his last seminal papers. In addition, his experience in writing, editing and refereeing was put to good use as he assisted Dr Scoresby Shepherd, editor of the Department's publications, with incisive criticism and polishing of manuscripts. In 1986, Grant Inglis was awarded the Verco Medal by the Royal Society of South Australia (of which he was president in 1970–71) for notable contributions to nematology.

During his life he produced more than a hundred papers, most of them scientific, amounting to over 1300 published pages. His most productive years scientifically, were before he took up administration at a senior level; notably during his fifteen years at the British Museum (Natural History) and first three years in South Australia. However, very few subsequent years went by without some significant contribution to the field and increasing attention to theoretical and philosophical aspects of the science of systematics. He wrote his seminal paper on the purpose and judgements of biological classification in 1970 whilst heavily embroiled in administrative duties at the South Australian Museum.

The majority of publications were concerned with the classification of nematodes or round worms, small animals that may be free-living, but also include important parasites of animals and plants. Inglis worked mainly on parasites of vertebrate animals. He not only described many new species, but also made substantial changes in their higher classification. His special ability lay in clarifying the structure of parts of these small, somewhat enigmatic animals, and that in the days before scanning electron microscopy was in general usage was some achievement. Often, what had been misinterpreted as similar and homologous structures were proved to be very different in their origins, requiring considerable changes in the classification. Later he moved on to free-living marine nematodes, and he once jokingly said that it was the sheer diversity of these that drove him into administration.

During his period of administrative responsibility, Inglis developed his scientific interests in areas which did not require so much time working with a microscope, at first in the functional morphology of muscles and body wall of round worms, and later, into the procedures of biological classification. In the latter he saw evolution as progressing in waves, leading to his establishment of a classificatory process he called *stratigramy*, rather than by branching from a single event as is the basis of accepted cladistic methodology.

His new role in the Department of Environment and Conservation also gave rise to writings of a different scale and flavour as, for some, radical new concepts of nature conservation had to be promulgated to a still-learning public and new policies had to be argued with officialdom.

One of his great achievements whilst Director of Environment and Conservation was the pioneering beverage container deposit legislation that was eventually passed by the South Australian Parliament. The remarkably clean roadsides to be seen as one enters South Australia from other states will be a lasting memorial to Inglis' tenacity in getting this model legislation to and through the State Parliament. And the deposits on soft drink cans which he pioneered are now the basis of a minor industry amongst the less well-off members of today's society. Their thrift and resourcefulness would no doubt have appealed to Grant Inglis' native instincts.

Grant recognised that protection of the environment resulted from foreseeing harmful effects and avoiding them. He was an enthusiastic proponent both at the state and national level of the introduction of environmental impact statements. He hoped museums would be a rich resource base for these studies, and

always insisted on the statements having a comprehensive biological basis.

With the incorporation of the Department of Fauna Conservation in 1972 into the Department of Environment and Conservation, Grant Inglis set about developing a systematic classification of the various properties that were formerly under the protection of that Department. He clearly recognised the multiple uses that parks had – conservation, recreation, and teaching purposes – and set in train the development of management plans for each of the parks.

Grant Inglis was an accomplished orator and thoroughly enjoyed public speaking. Once embarked on an administrative career, he took every opportunity to speak at conferences and seminars about environmental issues. He was in considerable demand nationally and was not averse to publicly advocating positions he was working towards.

He had an infectious – some would claim rambunctious – sense of humour, and he gathered about him a small circle of close friends. Despite heart trouble which had manifested itself before he turned 40, he enjoyed the good life and was an active member of Adelaide's Beef and Burgundy Club and all that that entailed. In 1980 and again in 1990, he underwent heart by-pass surgery, the first of which gave a new lease of life to his considerable energies.

A bachelor, Grant Inglis died of a massive heart attack in his beloved Scotland on 26 March 1991.

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